Overview of 2008 Pesticide Sales in Alberta

April 2011

Policy Division
Alberta Environment

ISBN (printed): 978-0-7785-9517-5
(On-line edition): 978-0-7785-9518-2

Website Address: http://environment.alberta.ca

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This report should be cited as:

Byrtus, G. 2011. Overview of 2008 Pesticide Sales in Alberta. Alberta Environment. Edmonton. 69 pp.

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Alberta Environment

EXECUTIVE SUMMARY

Alberta Environment undertook the collection, consolidation and analysis of pesticide sales data from pesticide vendors in Alberta for the 2008 calendar year. The objective was to document the volume and types of pesticides sold in Alberta, and to prepare a general overview of the sales data in relation to sectors of use, types of use, individual active ingredients, chemical groupings, as well as geographic breakdowns by river basin, municipality and Land Use Framework region. This project is an ongoing survey conducted every five years, with previous reporting undertaken for the years 1993, 1998 and 2003. The 1998 report followed the chemical grouping format used by Quebec in their reporting on pesticide sales in their province, and with the proposed National Pesticide Sales Database. The 2003 and 2008 reports also included individual active ingredient sales information as well as sales by chemical group.

Pesticide sales data was requested from registered wholesale and retail pesticide vendors in Alberta in early 2009, under the authority of the Environmental Protection and Enhancement Act and supporting regulations. Approximately 93% compliance with the sales data request was obtained. Sales data received was digitized or reformatted to a common database format. Six additional datasets were utilized to assist with sorting and categorizing the sales records by chemical or geographic groups. The datasets were brought into Microsoft Access, where they were linked and various queries were performed. All sales data reported on in this report is based upon pesticide active ingredient, not formulated product.

In 2008, a total of 12 476 095.8 kg of pesticide active ingredient (ai) was sold in, or shipped into, Alberta. Pesticides sold into the Agriculture sector accounted for 96.5% of all pesticides sold, with the Commercial/Industrial sector accounting for 2.7% of sales, and the Domestic sector accounting for 0.7% of sales. The types of pesticides sold were predominantly herbicides, at 82.2%. Adjuvants and surfactants made up the next largest category at 12.7%. Insecticides made up 1.9% of sales, while fungicides made up 3.1% of sales.

Of the chemical groups, the Phosphonic Acids, Phosphinic Acids group was the largest at 53.2% of overall sales by active ingredient. Sales in this group were made up primarily of glyphosate. However, in the Domestic sector, the Phenoxy Acids group dominated with 41.5% of pesticide active ingredient (mainly 2,4-D) sold.

Looking at geographic distribution of sales by outlet location related to major river drainage, sales in the Oldman River basin were highest overall at 19.6% of the total active ingredient sold, followed by sales within the Red Deer River basin at 16.6%, and the Battle River basin at 14.5%.

Pesticide sales were also sorted by natural regions. The Grassland Natural Region constituted over 48% of all pesticide active ingredient sales, mainly in the Dry Mixedgrass and Mixedgrass sub regions. The Parkland Natural Region contained over 36% of provincial pesticide sales, mainly in the Central Parkland sub-region. The majority of the remainder of pesticide sales was in the Dry Mixedwood sub-region of the Boreal Natural Region.

Geo-administrative regions were also summarized, for use in program planning. Land Use Framework regions (established since the 2003 report) were mapped along with reported sales. The South Saskatchewan region had over 40% of total sales by active ingredient, with the North Saskatchewan region having just over 25% of sales.

The municipalities with the highest total pesticide sales were the County of Lethbridge, the MD of Taber, Cypress County, Wheatland County and Vulcan County at over 500,000 kg of active ingredient.

Agricultural pesticide use intensities of over 2.0 kg ai/ha were estimated for the municipalities of Lethbridge, Taber and Cypress, based upon their cropped acreage and agricultural pesticide sales. This compares to an overall provincial estimated agricultural pesticide use intensity (based upon cultivated land acreage) of 1.02 kg ai/ha, considerably higher than the 0.78 kg ai/ha agricultural pesticide use intensity calculated for 2003. Other municipalities with over 300 000 kg ai of agricultural pesticide sales were the Counties of Forty Mile and Vermilion River, as well as Wheatland County, Camrose County, Rocky View County, Kneehill County and Vulcan County. Estimated pesticide use intensities for these municipalities ranged from 1.12 to 1.44 kg ai/ha. These municipalities may also serve as regional supply centres, so the use intensity estimates may be an overestimation.

The overview of pesticide sales data for Alberta has provided Alberta Environment and other agencies with the background data to enable comparisons to other regions, and to assist in ensuring that Alberta Environment has the appropriate regulatory framework in place for pesticides. The data will also be useful in identifying monitoring priorities for ongoing and upcoming monitoring programs.

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1.0 INTRODUCTION

Alberta Environment has been collecting pesticide sales data on a regular basis since 1993. Initial data collection (Cotton and Byrtus 1995) focused on agricultural sales from 1988 to 1993 and was utilized to inform the pesticide monitoring in surface waters carried out by Alberta Environment (Anderson 2005) and Alberta Agriculture and Rural Development in the early 1990's (CAESA 1998). This data was limited to about 50% of agricultural product sales, and only provided trend information and spatial perspective on certain products. Follow up surveys were done on a five year schedule (in 1998 and 2003), taking a more comprehensive look at pesticide sales in Alberta. Agricultural, domestic, commercial, livestock and structural sectors were surveyed (Byrtus 2000 and 2007). This information was used in the updating of pesticide monitoring programs conducted by Alberta Environment and Alberta Agriculture. Domestic sales data was extracted to provide extensive information on pesticide use by major urban centres in Alberta, and a separate survey of domestic sales was conducted annually following the 2003 survey to inform policy decisions related to domestic pesticide regulatory actions.

For 2008, Alberta Environment undertook its fourth provincial scale review of pesticide sales; using the same data collection and reporting process as was implemented for 1998 and 2003.

The data in this overview will assist Alberta Environment and other provincial and federal agencies in comparisons of pesticide sales/usage information. It will also help to identify monitoring priorities for ongoing monitoring programs and assist in planning for new programs. It will also assist Alberta Environment in ensuring that the appropriate regulatory framework is in place for the pesticides in current use in Alberta.

The specific objectives of this project were:

1. To assemble pesticide sales records representing pesticide use for the calendar year 2008.
2. To categorize pesticide sales by active ingredient, chemical group, sector of use, and geographic distribution

2.0 METHODS

2.1 Sales Data

Sales Data Collection

Alberta Environment maintains a registry of pesticide vendors that retail restricted and commercial registered pesticide products, as well as wholesale distributors of domestic class products. This registry is maintained as a component of the Environmental Management System (EMS), which tracks many of the approvals and registrations issued by Alberta Environment that fall under the *Environmental Protection and Enhancement Act (EPEA)*. Under the authority of this Act and its supporting regulations [*Pesticide (Ministerial) Regulation*], Alberta Environment can request pesticide sales records from vendors.

A letter was sent out to all registered vendors in Alberta and wholesale distributors in early 2009 requesting pesticide sales in Alberta for the calendar year 2008. Sales data was received throughout 2009 in various formats (hard copy and electronic). Records were received from approximately 93% of vendors that received sales record requests.

Hard copy records were manually entered into a standardized Excel file, while digital files were converted to the standardized database format, which contains the vendor approval number, product registration number, quantity sold in litres or kilograms, and sector of use. Individual vendor data files were consolidated into a single sales database, which contains almost 83,000 records.

Sales Data Limitations

Sector Representation

The data from vendors that are primarily agricultural suppliers may have also contained sales to the landscape industry, the industrial sector, municipal governments, golf courses and other non-agricultural sectors. As a result, the agricultural sector may be slightly over-represented, while the other sectors may be slightly under-represented for those products that have cross-sector utilization. Products that were sold by agricultural retailers, but that were only registered for non-cropland uses were classified as sales to the Commercial/Industrial sector.

Treated Seed

Sales of fungicide and insecticide treated seed was not targeted in this survey, however some sales records of treated seed were received, converted to a pesticide active ingredient equivalent, and reported. The collection of treated seed sales data was beyond the scope of this project, particularly as seed distribution is often done by seed vendors or seed divisions (not specifically regulated under EPEA) rather than agricultural chemical divisions of the large agricultural input companies. Most of the products used for custom seed treatment at seed cleaning plants were captured in this survey.

Vendor List

The vendors surveyed were based upon the vendors contacted in 2003, along with an updated list of CropLife certified warehouses, supplied by the Agricultural Warehouse Standards Association. Because of regulatory reform, not all pesticide vendors are registered under EPEA or under the CropLife warehouse program. For example, many of the livestock products have been exempted from vendor registration requirements. Therefore, the livestock product information is not complete. Also, the sales of disinfectants, anti-microbial products and wood preservatives are exempted from requiring a vendor registration, so there is virtually no sales data on those products.

Domestic Products

The sales records obtained from the agricultural and industrial sectors were considered reasonably accurate in terms of product sold, as they were obtained from systems reporting the point of sale for each product. On the other hand, domestic sales records came from distributors and wholesalers, as well as retail level point of sale, so there is some retail outlet based information, and some records based on sales or shipments within the province. It was assumed that the product shipped to the various domestic retail outlets in 2008 was sold in 2008. Also, some products were shipped through regional distribution systems, and some of that information was not accessed during the 2008 survey.

In the domestic sector, pet care products, spa and pool products, and most wood preservatives (paints and stains) sold in Alberta were not identified in this survey. Some miscellaneous household (indoor) pesticides were also missed in this survey, as they are classified as Schedule 4

products, which have been exempted from the provincial requirement of authorizations and tracking mechanisms.

Geographic Non-Specific Records

Some vendors were unable to identify retail outlets for their shipments for a variety of reasons. These sales data were identified as "Alberta", and as a result, would not be included in any geographical breakdown. These records would, however, be included in sector summaries, active ingredient listings, and chemical group summaries.

2.2 Pesticide Databases

In order to consolidate pesticide formulation sales information down to active ingredient and to chemical group, two separate databases were also incorporated. The first of the pesticide databases was the pesticide Product database, which was originally obtained from the Pesticide Management Regulatory Agency and updated with pesticide registrations issued up to and including 2008. Registrations for fertilizer-pesticide combinations under the Fertilizer Act were also added to this database. This database has information on the product registration number, active ingredient, guarantee, as well as product name, registration status, etc. This database currently has 17 611 records. The second pesticide database used was the Active database, which included active ingredient codes, active ingredient names, chemical family and chemical group. There are a total of 700 records in this database, which also includes disinfectants, antimicrobials and a number of historical active ingredients that are no longer registered or sold in Canada.

2.3 Geographic Databases

Four databases were used to identify the geographic distribution of pesticide sales information. The primary database was the Vendor database, which included the vendor registration number, along with the vendor name and location (e.g., city, town, village or hamlet). As a number of sales records were received from vendors that do not require vendor registrations in Alberta (primarily domestic retail vendors), additional vendor numbers were also generated for these. Additional vendor numbers were also generated for all municipalities in Alberta to enable geographic identification of minor vendors, or sales records to end users. Another major database was the City database, which lists all the municipalities in Alberta. Associated with each municipality was the corresponding reference for rural municipality, drainage basin, ecodistrict and Land Use Framework region. Secondary databases included Basin (which cross-referenced

drainage basin and river basins), and Natural Region (which cross-referenced ecodistrict and natural regions).

2.4 Data Processing

The databases and spreadsheets were imported into Microsoft Access for data processing and querying. The databases were linked by related fields to calculate active ingredient values, and subsequent data groupings by chemical group, sector of use, and geographic distribution (see Cotton and Byrtus 1995 for an example of how the calculations were done). Conversion of formulated product sales to kg of active ingredient (ai) is a common means of expressing pesticide sales/use in other jurisdictions (Gregoire 1997), although actual reporting is sometimes by chemical group or by sector of use instead of by quantities of individual active ingredients.

Assumptions were made with respect to pesticide formulations, such as the specific gravity of all pesticide formulations being 1.0. In 1998, *Bacillus* formulations were assumed to be 100% active ingredient. Information on actual percentages of active ingredient on a volume basis was obtained for products sold in 2003 and 2008, so *Bacillus* formulations are reported here as active ingredient instead of formulated product.

Products that contain more than one active ingredient were assigned an extension number to the PCP (Pest Control Products) number for each of the active ingredients involved in both the sales and product databases. This enabled the use of the existing registration numbers with only a minor modification, and also enabled the software used for the data processing to accurately identify each component of a formulation. However, this resulted in additional records being added to the sales database to account for each active ingredient in a formulation (approximately 20,000 records).

2.5 Data Breakdown

In order to simplify the analysis of the data, consolidation of the data based upon type of use, chemical group and sector of use was undertaken.

2.5.1 Type of Use

Under the PCP Act, pesticides are classified into 39 product types (herbicides, insecticides, fungicides, etc) of products, which reflect their type of use. For the purpose of this document, the categories have been reduced to 6 primary types of use. All of the active ingredients identified in

sales made in Alberta in 2008 are included in one of the types of use listed here. For those active ingredients that have multiple types of uses (such as thiram, which is a fungicide and a vertebrate repellent), the product is listed under its primary usage for Alberta. A slightly more detailed breakdown was conducted for Table 16 to align with the breakdown used by Quebec.

- Herbicides and plant growth regulators
- Insecticides, acaracides, repellents,
- Fungicides
- Vertebrate control products and vertebrate repellents
- Adjuvants/surfactants
- Other: (Soil fumigants, wood preservatives, disinfectants, anti-microbials)

As the primary focus of this survey was on traditional pesticides, and not anti-microbial or disinfectant pesticides, sales data from industrial and domestic cleaning agents were not obtained or included, although these are also registered under the PCP Act. Adjuvants and surfactants are widely used in the agricultural industry in Alberta, so these records were included as a separate category.

2.5.2 Chemical Group

The chemical groupings used in 2008 are based upon the groups established by the Quebec Ministry of Sustainable Development, Environment and Parks (Dion 2007), in order to enable comparison between the two provincial sales reporting systems. The Alberta surveys conducted in 1998 and 2003 utilized slightly different chemical grouping of pesticides, and comparison of those two year's of data to the 2008 chemical grouping data was not possible. The chemical groupings used in the overview are listed in Appendix 1, along with the active ingredients included in each chemical group.

2.5.3 Sector of Use

The intent of categorizing the sales by sector of use was to attempt to differentiate between various sectors and their relative usage of pesticides in Alberta. Initially, it was thought that the sales could be differentiated by product and by the vendor. For products such as home and garden pesticides (Domestic sector), and products used on livestock (Livestock sector), this was relatively easy. However, the sales records indicated that several of the vendors who sell agricultural products primarily, also sold herbicides that were primarily for turf, non-cropland, right of way (ROW) or landscape usage (Commercial/Industrial), and would not be used for

agricultural production purposes, except perhaps for pasture renovation. These records were categorized as Commercial/Industrial.

Some products have multiple sectoral uses such as agriculture, landscaping or ROW maintenance. As the end use for these products could not be distinguished, these purchases at agricultural vendors have been included under the Agricultural sector. The resulting breakdowns therefore, are simplified and may not accurately reflect actual sectoral usage in Alberta. Some general guidance on sectoral usage was provided by the use patterns identified in the Alberta Agriculture and Food publication "Crop Protection 2008" (AAF 2008).

The sectors of use used in this report include:

- Agricultural (products sold at agricultural outlets and that are approved for on-farm use)
- Domestic (products shipped to or sold at garden centres, hardware stores, etc)
- Commercial/Industrial (includes forestry, ROW, landscaping, golf courses, municipal & structural)
- Livestock (products sold for use on cattle, horses, sheep, etc)

The structural sector was reported as a separate sector in 2003, but was included in the Commercial/Industrial sector in 2008.

2.5.4 Geographic Units

2.5.4.1 River Basins

There are 13 major river basins located within Alberta. Within these river basins are numerous sub-basins or drainage basins, which define the watersheds of major and minor tributaries. In order to assist the interpretation of pesticide monitoring data for Alberta, which is generally reported by major river basin, and sometimes by sub-basin, identification of overall pesticide usage by river basin was required. All of the municipalities in the City database were identified as to their respective sub-basin. The major river basins in Alberta used for this report are based upon Prairie Farm Rehabilitation Administration basins, obtained from Alberta Agriculture and Food (Spiess 2005):

- Athabasca River
- Battle River
- Beaver River
- Bow River
- Hay River
- Milk River
- North Saskatchewan River
- Oldman River

- Peace River
- Red Deer River
- Sounding Creek
- South Saskatchewan River

2.5.4.2 Natural Regions

There are six major natural regions in Alberta, which contain a total of 21 subregions. To link pesticide sales to the various natural regions in Alberta, each municipality in the City database was allocated to an ecodistrict, which was then linked to the respective natural region in the Natural Region database. The detailed maps used to determine municipality location in relation to ecodistrict were obtained from Alberta Agriculture, Food and Rural Development (AAFRD 2003) and Strong and Thompson (1995). The natural regions identify different ecological zones within Alberta, which are influenced by soil type, climate, physiography, water, fauna, land use, and vegetative cover (Ecological Stratification Working Group 1995). The natural regions of Alberta (updated in 2005) are:

- Grassland
- Parkland
- Canadian Shield
- Foothills
- Rocky Mountain
- Boreal Forest

2.5.4.1 Land Use Framework

The Government of Alberta initiated a new program in 2006 to develop a provincial land use planning blueprint to better manage public and private lands and natural resources to achieve Alberta's long term goals (Land Use Secretariat 2008). The Land Use Framework is intended to balance economic, social and environmental interests competing to utilize the same land base. The provincial framework is broken down into seven regional planning areas, which are aligned by river basins at a broad scale, and by municipal boundaries at the fine scale. The seven planning areas are:

- Lower Athabasca
- Upper Athabasca
- Lower Peace
- Upper Peace
- North Saskatchewan
- Red Deer
- South Saskatchewan

2.5.4.2 Municipalities

There are about 88 municipalities (rural municipalities, cities and national parks) in Alberta. Pesticide sales were allocated to the municipality in which the vendor was located for data analysis by geo-political boundaries. In most situations, agricultural sales made at a vendor

located in a city were consolidated to the surrounding rural municipality (e.g., Camrose) for the purposes of sub-regional assessments and mapping purposes. The cities of Calgary and Edmonton were identified as distinct municipalities for this report.

2.6 Use Intensity

Pesticide use intensity, (kg of active ingredient used per hectare of land) is an inexact measurement, but it is often used to compare relative pesticide use between regions or countries with different land areas, or areas with different pesticide usage as a result of different crops requiring different pesticide inputs. It can also be used as a measure of relative pesticide use over time. In this report, pesticide sales by defined geographic area were considered representative of use, and the use intensity was calculated based on the land base for the defined geographic area. Use intensity was calculated based only on agricultural pesticide sales (excluding adjuvants).

3.0 RESULTS

In 2008, a total of 12 476 095.8 kg of active ingredient was sold in Alberta. The sales data are broken down as follows.

3.1 Type of Use

Herbicides and plant growth regulators (PGR's) made up the majority of pesticides sold in Alberta, at 82.2% (Table 1). The majority of the increase in sales between 2003 and 2008 was attributed to the increase in sales of herbicides.

Fungicides made up a much smaller proportion (slightly over 3%), while insecticides made up less than 2% of sales. In 2003, insecticides made up a greater proportion of sales as a result of a grasshopper outbreak that year.

Table 1. Pesticide Sales by Type of Use

Type of Use	2008 Kg ai	2008 (%)	2003 kg ai	2003 %
Herbicides, PGR's	10 257 303.0	82.2	7 158 660.3	77.3
Insecticides, Acaracides, Repellents	236 168.7	1.9	433 176.1	4.7
Fungicides	388 560.4	3.1	319 464.5	3.4
Vertebrate Control Products and Vertebrate Repellents	12 458.4	0.1	1 712.9	0.02
Adjuvants and Surfactants	1 580 103.8	12.7	1 350 159.8	14.6
Other	1 501.4	0.01	1 313.9	0.01
Total	**12 476 095.8**	**100**	**9 264 487.7**	**100**

Vertebrate control products and repellents made up a very small percentage of pesticide sales, at 0.1%. These were predominantly products used for controlling Richardson's ground squirrel and pocket gophers.

Adjuvants and surfactants made up the second largest group, in terms of percentage of sales. These compounds are used to enhance the effectiveness of the herbicides on the target weed(s). They have been categorized as a separate type of use, but because they are virtually always used in conjunction with a herbicide, they could be considered a component of the Herbicide group.

The adjuvants used to be predominantly packaged with the herbicides, and issues with leftover adjuvant disposal led to changes in packaging to decouple the adjuvant from the herbicide. Even

with the decoupling (implemented after the 2003 sales reporting), the adjuvant sales remained high, likely in conjunction with increased herbicide usage.

The "Other" category includes sales for products that do not fit the named categories, and for which only a limited number of sales records were received. This category includes wood preservatives, disinfectants, slimicides and soil fumigants. As the disinfectants and slimicides are exempted under the provincial pesticide regulations, and the focus of the sales survey was primarily on the traditional pesticides, very little information on these products was obtained.

3.2 Chemical Group

The sales records were also broken down by chemical group (Table 2), as outlined in Appendix 1. The chemical groups were aligned with the Quebec Ministry of Sustainable Development, Environment and Parks listings (Dion 2007) to enable provincial comparison of sales data (Appendix 2). The chemical group with the largest proportion of sales was the Phosphonic Acids, Phosphinic Acids group at 53.2 % (up from 38.1% in 2003), followed by the Phenoxy Acids at 17.1%. The next groups were the Fatty Acids & Surfactants and Hydrocarbons in the 5-7% range. These four groups consist of the major herbicides (and adjuvants/surfactants) used in Alberta. The remaining chemical groups were all under 5%, and 47 of the 54 chemical groups were under 1% of total sales.

Table 2. Summary of Pesticide Sales by Chemical Group (all sectors)

Chemical Grouping	Kg ai	Percentage %
Phosphonic Acids, Phosphinic Acids	6 633 567.6	53.2
Phenoxy Acids	2 130 654.7	17.1
Fatty Acids & Surfactants	924 680.7	7.4
Hydrocarbons	659 521.1	5.3
Benzonitriles	366 443.3	2.9
Cyclohexanedione oximes	191 948.1	1.5
Dinitrobenzenes	118 607.6	1.0
Thiocarbamates	112 096.2	0.9
Imidazolinones	111 806.9	0.9
Aryloxyphenoxyl Acids	110 792.2	0.9
Triazoles	104 706.9	0.8
Biscarbamates	102 813.6	0.8
Benzoic Acid & Derivatives	94 908.1	0.8
Halogenated Organic Acids	88 074.6	0.7
Acylureas	85 612.4	0.7
Thiophosphates	85 271.0	0.7

Pyridines	72 411.4	0.6
Inorganics, Other	64 911.7	0.5
Dithiophosphates	57 202.3	0.5
Urea Derivatives	47 686.2	0.4
Azoles, Oxazoles, Thiazoles	41 280.5	0.3
Ammoniums, Quaternary	40 722.8	0.3
Sulfonylureas	27 844.2	0.2
Phthalic Acids	27 137.5	0.2
Anilides	26 918.2	0.2
Methoxyacrylates	20 532.1	0.2
Miscellaneous (Non-Classified)	18 881.7	0.2
Carbamates	15 688.9	0.13
Morpholines & Oxathiines	15 453.0	0.12
Organic Acids	12 048.4	0.10
Chlorotriazines	10 953.3	0.09
Nitrobenzenes	7 627.0	0.06
Guanidines	6 849.5	0.05
Organohalogens	6 106.3	0.05
Triazines, Tetrazines	5 919.3	0.05
Alcohols	5 853.1	0.05
Pyrethroids, Pyrethrins	5 717.9	0.05
Inorganic Coppers	4 141.5	0.03
Oils, Mineral and Vegetable	3 925.8	0.03
Benzamides	1 694.3	0.01
Diazines	1 291.1	0.01
Pheromones	1 274.0	0.01
Phosphates	1 077.6	0.01
Organochlorines	830.3	0.01
Phosphoramidothioates	626.2	0.01
Aldehydes	569.4	0.00
Microbials	420.4	0.00
Dithiocarbamates	392.0	0.00
Amides	270.9	0.00
Inorganic Zincs	179.8	0.00
Chromenones	61.9	0.00
Oximes-Carbamates	57.2	0.00
Indanediones	24.6	0.00
Organometallics	8.6	0.00
Total	**12 476 095.8**	**100.0**

3.3 Sector of Use

Pesticide sales broken down by sector of use are listed in Table 3. As expected, agricultural use dominates pesticide sales in Alberta at 96.5%. The next sector was the Commercial/Industrial sector at 2.7%. Domestic pesticide sales made up only 0.7% of total sales by active ingredient. The Livestock sector made up less than 0.1% of all sales. The sectoral breakdowns were comparable to 2003 results.

Further breakdown of the sector sales by type of use was conducted to assess if the overall trends in type of use was consistent within each sector. Figures 1-3 show the breakdowns for each sector.

Table 3. Pesticide Sales by Sector

Sector	Kg ai	Percentage (%)
Agriculture	11 985 047.9	96.1
Commercial/Industrial	388 537.0	3.1
Domestic	89 533.6	0.7
Livestock	12 977.3	0.1
Total	**12 476 095.8**	**100.0**

3.3.1 Agricultural Sector

Herbicides made up the majority of pesticide use in the agricultural sector, with 82% of all sales. Adjuvants were the next highest category, at over 13% of pesticide use. Adjuvants and surfactants are widely used to enhance the application and effectiveness of herbicides. Insecticide and fungicide use were each below 3% of agricultural pesticide sales in Alberta.

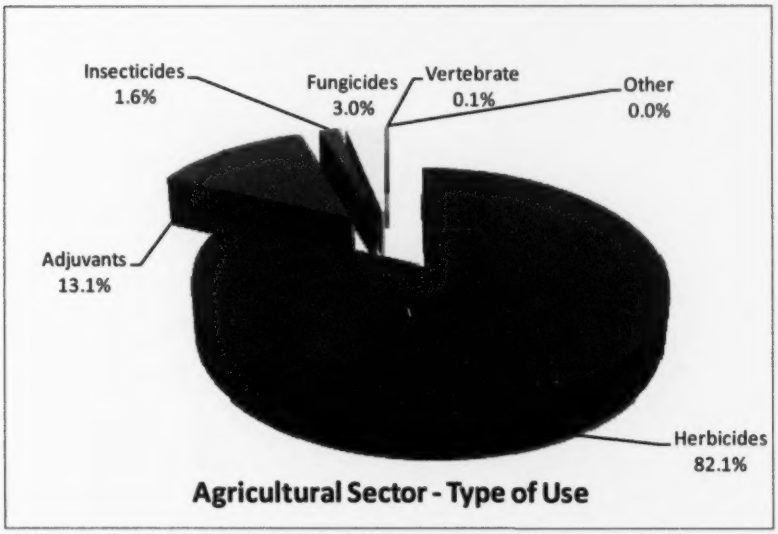

Figure 1. Agriculture Sector – Type of Use

The top 15 active ingredients sold in the agricultural market in Alberta in 2008 are listed in Table 4, with comparisons to the agricultural sales of those active ingredients in 2003 and 1998. Overall, there was little change in the order of the top selling products, although some changes were observed as a result of changes in agronomic practices or product replacements. Substantial increases (>20%) were observed for glyphosate, 2,4-D and glufosinate. Glufosinate sales increased 270%, while glyphosate sales increased by 85% over 2003 volumes.

Substantial reductions in sales were again observed for triallate and ethalfluralin, both of which are pre-emergent herbicides used for wild oat control. Further utilization of zero tillage across Alberta (both products require incorporation after application), and continued movement towards herbicide tolerant canola systems, is moving producers away from these products and towards products such as glyphosate and glufosinate for broad spectrum weed control.

The sales of chlorpyrifos (and other insecticides) decreased substantially compared to 2003, as the widespread grasshopper problems experienced in 2003 did not recur in 2008.

Table 4. Top 15 Agricultural Active Ingredients Sold in 2008, 2003 and 1998

Active Ingredient	Usage	2008 Sales (kg ai)	2003 Sales (kg ai)	1998 Sales (kg ai)	% Change (2003 to 2008)
Glyphosate	Herbicide	6 125 309.7	3 333 994.5	2 627 599.3	+83.7%
MCPA	Herbicide	1 028 115.8	1 096 848.9	884 937.5	-6.3%
2,4-D	Herbicide	840 464.6	685 294.5	674 902.6	+22.6%
Petroleum Hydrocarbon Blend	Adjuvant	656 588.2	559 728.7	368 704.3	+17.3%
Surfactant Blend	Adjuvant	401 107.1	437 400.5	496 177.7	-8.3%
Glufosinate	Herbicide	394 652.8	106 689.6	63 400.8	+270%
Bromoxynil	Herbicide	330 177.1	354 906.6	268 105.3	-7.0%
Paraffin Base Mineral Oil	Adjuvant	188 738.7	192 634.4	192 708.2	-2.0%
Methylated Canola Oil	Adjuvant	187 385.6	0	0	--
Tralkoxydim	Herbicide	147 916.9	141 226.1	126 323.5	+4.7%
Triallate	Herbicide	101 072.2	197 221.4	693 269.3	-48.8%
Imazamethabenz	Herbicide	94 004.3	138 551.4	173 679.2	-32.2%
Ethalfluralin	Herbicide	82 873.7	168 135.0	452 294.4	-50.7%
Chlorpyrifos	Insecticide	82 725.3	197 004.7	215 779.6	-58.0%
Dicamba	Herbicide	77 852.0	108 637.8	118 739.8	-28.3%

In order to better compare the sector sales to sales information from Quebec, the chemical group breakdown was conducted on the agricultural pesticide sales (Table 5). The chemical group breakdown was changed significantly to align with the Quebec system (Dion 2007), and as a result, there are no comparisons for most chemical groups between 2003 and 2008.

The Phosphonic/Phosphinic Acids group dominated the agricultural sales at over 54%. The Phenoxy Acids group followed this at just over 16%. The surfactants (Fatty Acids, Surfactants and Hydrocarbons) comprised the next two groups, making up a total of 13% of total agricultural sales. The remaining groups comprised less than 3% or less individually, or slightly over 16% combined.

Table 5. Summary of Agricultural Pesticide Sales by Chemical Group

	2008	
Chemical Group	**Kg ai**	**%**
Phosphonic Acids, Phosphinic Acids	6 522 273.7	54.4
Phenoxy Acids	1 938 624.1	16.2
Fatty Acids & Surfactants	918 522.1	7.7
Hydrocarbons	656 588.2	5.5
Benzonitriles	362 733.9	3.0
Cyclohexanedione oximes	191 948.1	1.6
Dinitrobenzenes	118 607.6	1.0
Thiocarbamates	112 096.2	0.9
Aryloxyphenoxyl Acids	110 792.2	0.9
Imidazolinones	108 067.7	0.9
Triazoles	100 015.6	0.8
Biscarbamates	99 910.8	0.8
Thiophosphates	85 072.1	0.7
Acylureas	81 590.3	0.7
Benzoic Acid & Derivatives	78 065.3	0.7
Pyridines	72 222.2	0.6
Halogenated Organic Acids	68 986.3	0.6
Dithiophosphates	50 761.6	0.4
Inorganics, Other	46 177.8	0.4
Azoles, Oxazoles, Thiazoles	41 210.3	0.3
Ammoniums, Quaternary	40 464.0	0.3
Sulfonylureas	27 585.8	0.2
Anilides	26 870.7	0.2
Phthalic Acids	26 841.1	0.2
Methoxyacrylates	20 243.1	0.2
Urea Derivatives	15 969.3	0.1
Morpholines & Oxathiines	14 366.9	0.1
Chlorotriazines	10 785.3	0.09
Carbamates	8 034.9	0.07
Miscellaneous (Non-Classified)	6 834.3	0.06
Guanidines	6 770.1	0.06
Triazines, Tetrazines	5 916.6	0.05

Pyrethroids, Pyrethrins	3 479.7	0.03
Inorganic Coppers	3 407.7	0.03
Diazines	940.1	0.008
Phosphates	809.9	0.007
Phosphoramidothioates	415.7	0.003
Benzamides	397.5	0.003
Organochlorines	256.5	0.002
Microbials	124.1	0.001
Amides	121.3	0.001
Nitrobenzenes	76.6	0
Oximes-Carbamates	24.3	0
Inorganic Zincs	23.6	0
Aldehydes	8.9	0
Chromenones	6.8	0
Organic Acids	5.0	0
Indanediones	1.8	0
Total	**11 985 047.9**	**100**

3.3.2 Domestic Sector

In the domestic sector (Figure 2), herbicides again dominated at just over 68%, however insecticide sales made up a significant proportion of pesticide sales at over 27%. Fungicide sales were proportionately similar to agricultural fungicide sales, at close to 3%.

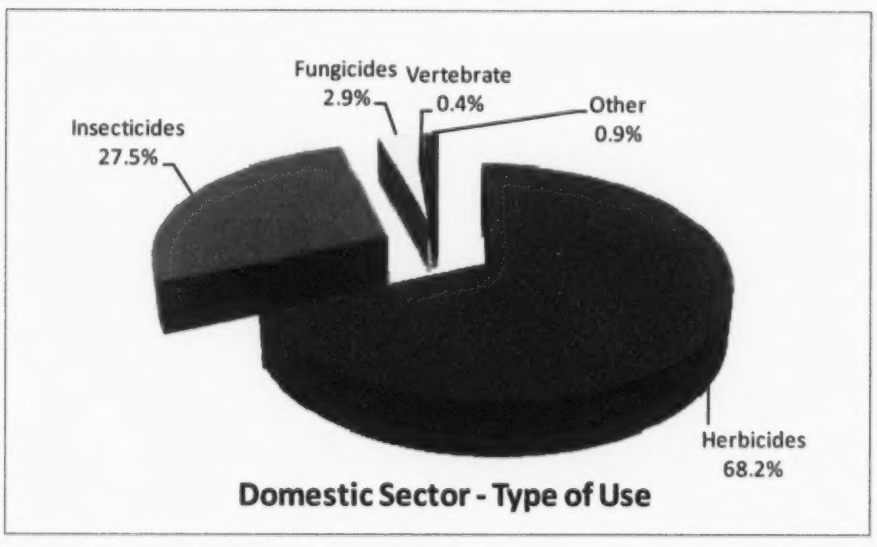

Figure 2. Domestic Sector – Type of Use

As with the agricultural products, the domestic product sales were also broken down by chemical group (Table 6). In the Domestic sector, the Phenoxy Acids dominated at over 41% of total

pesticide sales, followed by Inorganics and Phosphonic/Phosphinic Acids. These three groups combined made up over 73% of all domestic sales.

Table 6. Summary of Domestic Pesticide Sales by Chemical Group - 2008

Chemical Group	Kg ai	%
Phenoxy Acids	37 194.2	41.5
Inorganics, Other	16 388.0	18.3
Phosphonic Acids, Phosphinic Acids	12 195.8	13.6
Carbamates	5 451.6	6.1
Dithiophosphates	3 138.0	3.5
Hydrocarbons	2 932.9	3.3
Fatty Acids & Surfactants	2 241.5	2.5
Organic Acids	1 843.7	2.1
Oils, Mineral and Vegetable	1 729.5	1.9
Miscellaneous (Non-Classified)	1 604.6	1.8
Benzamides	1 201.7	1.3
Benzoic Acid & Derivatives	904.7	1.0
Inorganic Coppers	593.3	0.7
Pyrethroids, Pyrethrins	576.0	0.6
Organochlorines	510.3	0.6
Biscarbamates	223.7	0.2
Phthalic Acids	211.6	0.2
Inorganic Zincs	153.5	0.2
Chlorotriazines	134.2	0.1
Phosphates	112.6	0.1
Aldehydes	104.5	0.1
Triazoles	44.7	0.05
Chromenones	34.9	0.04
Microbials	3.8	0.0
Alcohols	1.3	0.0
Amides	1.2	0.0
Indanediones	0.8	0.0
Diazines	0.4	0.0
Pheromones	0.2	0.0
Ammoniums, Quaternary	0.15	0.0
Azoles, Oxazoles, Thiazoles	0.03	0.0
Thiophosphates	0.009	0.0
Total	**89 533.6**	**100.0**

The top domestic products sold in 2008 are listed in Table 7. Turf herbicides dominated (2,4-D and mecoprop), while glyphosate sales were also high. Glyphosate (and glufosinate) sales have increased as other total vegetation control products (e.g., atrazine, bromacil, etc) have been removed from the domestic market. Ferrous sulfate (used for moss control) sales have increased significantly since 2003. Silicon dioxide (salt water fossils) sales remained high in 2008, as products containing this active ingredient are being more widely utilized for insect control in indoor situations. A new formulation of fresh water fossils was also sold in 2008. Carbaryl sales, primarily used for ant control, increased as it was being used as a replacement for some of the organophosphate products removed from the domestic market (e.g., diazinon, dimethoate).

Table 7. Top 15 Domestic Active Ingredients Sold in 2008, 2003 and 1998

Domestic active ingredient	2008 Kg ai	2003 kg ai	1998 kg ai
2,4-D	25 107.2	14 392.5	22 505.1
Mecoprop	12 087.0	6 273.8	9 313.6
Glyphosate	11 167.6	10 448.5	6 099.4
Ferrous sulfate	7 846.4	1 593.4	1 818.7
Silicon dioxide salt water fossils	6 666.6	7 509.2	2 962.7
Carbaryl	5 433.4	3 151.9	1 292.2
Malathion	3 116.7	1 667.8	2 655.6
Naphthalene	2 318.2	118.5	1 371.6
Acetic acid	1 815.5	1 130.5	0.0
Mineral oil (Insecticidal or adjuvant)	1 701.4	838.9	2 986.9
Soap	1 331.8	815.8	1 211.1
Deet	1 201.7	3 413.3	3 972.2
Glufosinate ammonium	1 028.2	564.4	463.0
Sulphur (fungicide)	943.2	722.8	957.5
Dicamba	894.0	440.7	689.3

3.3.3 Commercial/Industrial Sector

In the Commercial/Industrial Sector, herbicides again dominated at 90% of pesticide sales (Figure 3). Insecticides made up over 3%. Fungicide sales were proportionately slightly higher in this sector at 5%, a reflection of fungicide sales to the golf course industry. Table 8 provides a more detailed breakdown of the top 15 active ingredients that were classified as being sold and used in the commercial/industrial sectors, and reflects the dominance of products sold and used for industrial site and right-of-way maintenance. Methyl bromide sales were reported in 2008, and this was for a flour mill fumigation under a critical use exemption permit for this product.

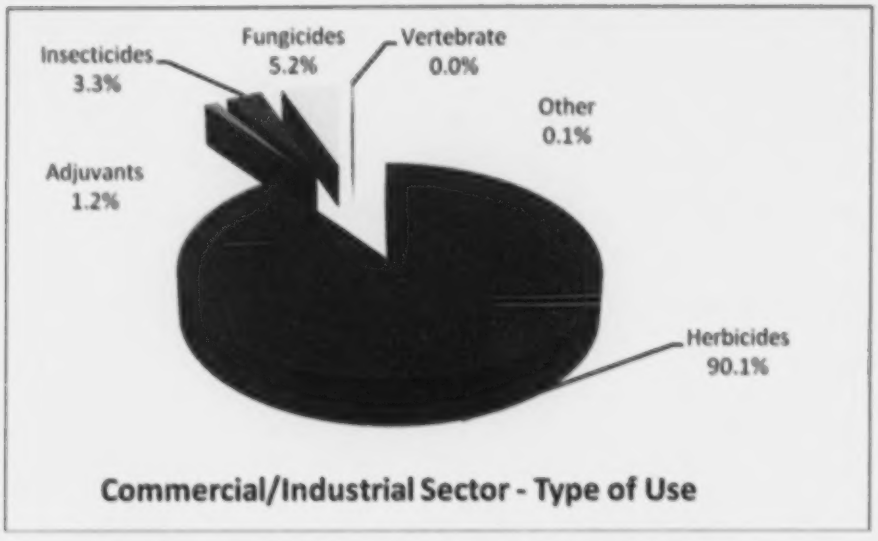

Figure 3. Commercial/Industrial Sector – Type of Use

Table 8. Top 15 Commercial/Industrial Active Ingredients Sold in 2008, 2003 and 1998

Commercial/Industrial Active Ingredient	2008 kg ai	2003 kg ai	1998 kg ai
2,4-D	107 510.5	63 670.6	68 412.7
Glyphosate	99 021.2	75 379.1	49 050.2
Diuron	31 707.3	28 960.0	9 627.5
Triclopyr	23 932.8	29 625.6	29 908.8
Mecoprop	19 933.7	12 288.0	10 991.2
Dicamba	15 931.9	12 344.2	18 849.5
Picloram	14 574.7	13 302.3	14 633.6
Acetic acid	10 095.0	425.0	0.0
Acrolein	9 051.0	16 981.4	17 520.5
Quintozene	7 528.8	6 829.0	9 808.8
Methyl bromide	6 106.3	0.0	0.0
Amitrole	3 929.3	2.3	0.0
Imazapyr	3 739.2	1 675.8	200.6
Chlorothalonil	3 605.0	4 363.5	6 768.3
Aminopyralid	3 539.6	0.0	0.0

The Commercial/Industrial sector sales were also broken down by chemical group (Table 9). In this sector, the Phenoxy Acids were the largest group by sales, with the Phosphonic/Phosphinic Acids following. These two groups of herbicides made up over 65% of total sales in this sector, reflecting the predominance of the industrial facility maintenance and commercial landscape industries in this sector.

Table 9. Summary of Commercial/Industrial Pesticide Sales by Chemical Group - 2008

Chemical Group	Kg ai	%
Phenoxy Acids	154 836.4	39.9
Phosphonic Acids, Phosphinic Acids	99 098.0	25.5
Urea Derivatives	31 716.9	8.2
Halogenated Organic Acids	19 088.3	4.9
Benzoic Acid & Derivatives	15 938.2	4.1
Organic Acids	10 199.7	2.6
Miscellaneous (Non-Classified)	9 139.3	2.4
Nitrobenzenes	7 550.4	1.9
Organohalogens	6 106.3	1.6
Triazoles	4 646.5	1.2
Acylureas	4 022.2	1.0
Fatty Acids & Surfactants	3 917.1	1.0
Imidazolinones	3 739.2	1.0
Benzonitriles	3 709.4	1.0
Biscarbamates	2 679.0	0.7
Oils, Mineral and Vegetable	2 196.3	0.6
Alcohols	1 690.2	0.4
Carbamates	1 399.8	0.4
Morpholines & Oxathiines	1 086.1	0.3
Inorganics, Other	1 031.9	0.3
Pyrethroids, Pyrethrins	456.2	0.1
Aldehydes	456.0	0.1
Dithiophosphates	421.9	0.1
Dithiocarbamates	392.0	0.1
Diazines	350.6	0.1
Microbials	292.5	0.1
Methoxyacrylates	289.0	0.1
Ammoniums, Quaternary	258.7	0.1
Sulfonylureas	258.3	0.1
Phosphoramidothioates	210.5	0.1
Thiophosphates	195.4	0.1
Pheremones	176.5	0.05
Phosphates	155.1	0.04
Amides	148.4	0.04
Inorganic Coppers	140.5	0.04
Benzamides	94.9	0.02
Guanidines	79.3	0.02
Phthalic Acids	72.0	0.02
Azoles, Oxazoles, Thiazoles	70.1	0.02
Organochlorines	63.5	0.02
Anilides	47.5	0.01
Pyridines	44.3	0.01
Chlorotriazines	33.8	0.01
Indanediones	22.1	0.01
Organometallics	8.6	0.0

Triazines, Tetrazines	2.7	0.0
Inorganic Zincs	2.7	0.0
Oximes-Carbamates	2.4	0.0
Chromenones	0.5	0.0
Dinitrobenzenes	0.00004	0.0
Total	**388537.0**	**100.0**

3.3.4 Other Sectors

Pesticide sales in the Livestock sector consisted of primarily repellents or insecticides, used for direct application to livestock or as space controls or repellents in the buildings used for sheltering livestock. The top four products by sales (with sector sales percentages and specific uses) were butoxypropylene glycol (32% - repellent), malathion (22% - insecticide), sulphur (10% - insecticide used in combination with rotenone) and piperonyl butoxide (10% - synergist used with pyrethrins).

3.4 Geographic Distributions

3.4.1 Drainage Basin

3.4.1.1 Agricultural Usage

Sales of all agricultural products (excluding adjuvants) were broken down by drainage basin (Table 10 and Figure 4). The Oldman River basin had the highest proportion of agricultural pesticide sales, at almost 20%, followed by the Red Deer River basin, the Battle River and the North Saskatchewan River basin. The Peace River basin also had over 11% of total agricultural pesticide sales, while the remaining basins were all below 10%.

Table 10. Agricultural Pesticide Sales (excluding adjuvants) by River Basin

	2008		2003	
River Basin	**Kg ai**	**(%)**	**Kg ai**	**(%)**
Oldman River	2 068 309.6	19.9	1 615 182.5	21.4
Red Deer River	1 770 580.7	17.0	1 334 005.1	17.6
Battle River	1 544 739.9	14.8	1 108 136.4	14.6
North Saskatchewan River	1 393 229.6	13.4	1 137 851.8	15.0
Peace River	1 202 936.2	11.6	731 480.1	9.7
South Saskatchewan River	872 798.3	8.4	647 561.2	8.6
Bow River	825 266.5	7.9	536 221.4	7.1
Athabasca River	360 375.6	3.5	234 328.2	3.1
Sounding Creek	213 163.7	2.0	113 392.8	1.5
Milk River	79 640.0	0.8	34 858.4	0.5
Beaver River	77 237.5	0.7	64 767.2	0.9
Non-specific basin	1 368.5	0.0	4 069.1	0.05
Total	**10 409 646.5**	**100**	**7 561 853.9**	**100**

3.4.1.2 Domestic Pesticide Sales by River Basin

Sales of domestic products were also broken down by river basin (Table 11). In this category, sales by river are influenced by the two major population centres in Alberta and their metropolitan areas: Calgary and Edmonton. The North Saskatchewan and Bow River basins had the largest sales by basin, followed by the Battle and Red Deer River basins. All basins (except for the Sounding Creek, Milk River and Hay River basins) increased in sales volumes from 2003, with the largest proportional sales volume increase observed in the Battle River. Some of the increase could be attributed to better spatial resolution in the sales data provided, as the sales volumes not assigned to a river basin dropped by over 11 000 kg in 2008 even though overall sales went up.

Table 11. Total Domestic Pesticide Sales by River Basin

River Basin	2008 Kg ai	2003 Kg ai
North Saskatchewan	26 095.2	10 248.9
Bow River	20 276.6	10 652.4
Battle River	9 785.4	2 370.5
Red Deer River	7 208.1	3 710.2
Oldman River	5 106.9	2 638.9
Athabasca River	4 015.1	2 777.8
Peace River	3 532.3	2 244.5
South Saskatchewan River	2 816.8	1 602.0
Beaver River	912.1	368.9
Sounding Creek	88.8	157.3
Milk River	42.5	45.0
Hay River	2.5	0.5
Non-specific basin	9 651.3	21 894.9
Total	**89 533.6**	**58 711.7**

3.4.2 Pesticide Sales by Natural Region

Pesticide sales were also broken down by natural region to assess pesticide sales/usage in relation to the natural regions in Alberta, which represent areas of comparable soils, climate and vegetation (Table 12). This information is of interest in relation to cropping practices that are often comparable within these regions.

Pesticide sales were concentrated in three natural regions in Alberta (Table 12) (Boreal, Grassland and Parkland). The largest amount of pesticide sold, at over 32% of provincial sales,

was in the Central Parkland sub-region. The Dry Mixedgrass sub-region was next at 18.3 %, followed by the Mixedgrass sub-region at 17.1%, and the Dry Mixedwood sub-region at 13.3%. Overall, the Grassland and Parkland natural regions comprised the bulk of sales within the province.

Mapping of the sales by natural region was also conducted, with Figure 5 displaying the geographical locations of the natural regions and sub-regions.

Table 12. Total Pesticide Sales by Natural Region

Natural Region	Sub Region	2008 kg ai	2008 %	2003 kg ai
Alberta (non-specific region)		**217 799.0**	**1.7**	**213 905.0**
Boreal	Central Mixedwood	21 549.7	0.2	31 486.3
	Dry Mixedwood	1 664 332.9	13.3	1 126 572.7
	Lower Boreal Highlands	2.4	0.0	0.5
Boreal Total		**1 685 885.0**	**13.5**	**1 158 059.5**
Foothills	Lower Foothills	5 652.2	0.04	10 557.4
	Upper Foothills	15.0	0.0	29.1
Foothills Total		**5 667.1**	**0.04**	**10 586.5**
Grassland	Dry Mixedgrass	2 284 841.7	18.3	1 831 323.8
	Foothills Fescue	1 061 066.0	8.5	711 924.8
	Mixedgrass	2 128 080.6	17.1	1 414 122.2
	Northern Fescue	584 808.0	4.7	328 584.0
Grassland Total		**6 058 796.4**	**48.6**	**4 285 954.8**
Parkland	Central Parkland	3 986 293.9	32.0	3 258 822.0
	Foothills Parkland	8 898.9	0.1	2 113.7
	Peace River Parkland	510 644.9	4.1	334 291.9
Parkland Total		**4 505 837.6**	**36.1**	**3 595 227.6**
Rocky Mountain	**Montane**	**2 110.7**	**0.02**	**754.3**
Total		**12 476 095.8**	**100**	**9 264 487.7**

3.4.2 Total Pesticide Sales by Land Use Framework Region

The Government of Alberta initiated a new program in 2006 to develop a provincial land use planning blueprint to better manage public and private lands and natural resources to achieve Alberta's long term goals (Land Use Secretariat 2008). The Land Use Framework is intended to balance economic, social and environmental interests competing to utilize the same land base. The provincial framework is broken down into seven regional planning areas, which are aligned by river basins at a broad scale, and by municipal boundaries at the fine scale.

Because the Land Use Framework (LUF) boundaries roughly align with river basins, there is some alignment in Table 13 with Table 10 (agricultural sales by basin) and Table 11 (domestic sales by basin). However, the northern basins (Peace and Athabasca) are broken into two LUF regions (Upper and Lower), while the Bow, Oldman and South Saskatchewan basins are combined into one LUF region (South Saskatchewan). The Battle River is incorporated into the North Saskatchewan region, while the Beaver River is encompassed into the Lower Athabasca region (Figure 6).

The consolidation of three river basins into the South Saskatchewan region results in this region having the largest volume of sales, at over 40% of the provincial total. The bisection of the two largest river basins in Alberta (Athabasca and Peace) into Upper and Lower regions limits the relative sales for these four regional planning areas.

Table 13. Total Pesticide Sales by Land Use Framework Region

Land Use Framework Region	Kg ai	%
Alberta	217 799.0	1.8
Lower Athabasca	70 997.7	0.6
Upper Athabasca	434 667.3	3.5
Lower Peace	355 240.3	2.9
Upper Peace	1 049 653.6	8.4
North Saskatchewan	3 139 318.3	25.2
Red Deer	2 136 500.6	17.1
South Saskatchewan	5 071 919.0	40.6
Total	**12 476 095.8**	**100**

3.4.3 Pesticide Sales by Municipality

Agricultural pesticide sales were broken out by rural municipality to provide a detailed geo-administrative overview of sales, using Alberta rural municipal boundaries. The largest volume of sales (agricultural products excluding adjuvants) occurred in the County of Lethbridge and the Wheatland County (>500,000 kg ai), which are major supply and distribution centres for southern Alberta. Municipalities with greater than 300 000 kg ai of sales were the MD of Taber, Cypress, Vulcan, Vermilion River, Forty Mile, Camrose, Rocky View and Kneehill Counties. These are large municipalities with the highest proportion of total crop area in Alberta (AARD 2009). Data on primary crops grown in 2006 in the five municipalities with the highest use intensity (>1.5 kg/ha) was derived from the 2006 Census of Agriculture (AARD 2009)(Table 14). Acreages for major crop groups varied among municipality, however cereals (primarily wheat) dominated in

each municipality. Oilseeds (primarily canola) did not have relatively high acreage in comparison to wheat except in Camrose County. Potatoes and sugar beets accounted for most of the Other Field Crops grown in Taber and Lethbridge, while field peas and dry beans were extensively grown in the other municipalities. Vegetable production was predominately in the irrigated municipalities of Taber and Lethbridge, while Hay and Forage acreage was largest in Cypress County. Statistics Canada included more data on chemfallow acreage in 2006, so this data was included in the summary table, as chemfallow represents a significant usage of herbicide products.

The range of crop types in various municipalities influences the type of pesticides used, as well as the use intensity (rate and frequency of application). Potatoes and sugar beets use very different products than cereals and oilseeds, and pesticide use is often more intensive on these types of crops for disease suppression, weed control and insect control. This is reflected in the use intensities for Taber and Lethbridge, which are again the top two municipalities for use intensity. These municipalities may also serve as regional supply centres, so the use intensities for these two municipalities may be a slight overestimation.

Table 14. Breakdown by Municipality of 2006 Crop (ha), Agricultural Pesticide Sales (2008 kg ai), and Use Intensity (kg ai/ha)

Crop Group	Alberta	Lethbridge	Taber	Cypress	Wheatland	Camrose
Cereals (acres)	4 788 061	130 824	100 999	100 999	204 355	113 919
Mixed Grains (acres)	150 950	1 536	641	2 261	811	3 802
Oilseeds (Canola, flax, soy - acres)	1 671 984	17 345	18 507	11 392	53 999	72 509
Other Field crops (acres)	520 330	21 991	50 982	12 268	8 159	10 808
Vegetables (acres)	5 339	448	2 836	0	17	0
Hay & Forage (acres)	2 426 493	31 016	18 896	48 098	33 249	30 852
Summerfallow(chem.-fallow) (acres)	658 862	15 575	17 222	42 048	24 543	2 242
Total Crop & Chemfallow (ha)	10 222 020	218 736	210 082	217 065	325 132	234 131
Agric Sales (excl Adj) (kg)	10 409 647	837 185	487 640	446 481	516 887	362 337
Use Intensity (kg/ha)	1.02	3.83	2.32	2.06	1.59	1.55

Total sales (all sectors and all products) for all of the municipalities in Alberta are summarized in Table 15. Sales by municipality data are biased slightly by the location and distribution of vendors. Some municipalities have extensive agricultural operations with a limited number of outlets, while other municipalities serve as regional supply outlets, and their sales may be slightly

over represented in the breakdown (e.g., Lethbridge). Sales data not allocated to a specific municipality was included in the "Alberta" total.

As in previous years, the large and predominantly agricultural municipalities had the highest sales, with Lethbridge, Wheatland, Taber, Cypress, and Vulcan Counties having the highest sales. At the other end of the spectrum, pesticides sold in the National Parks were primarily domestic lawn and garden products. A graphical depiction of pesticide sales by municipality is given in Figure 7.

Table 15. Total Pesticide Sales by Municipality (2008)

Municipality	Kg ai	Municipality	Kg ai	Municipality	Kg ai
Lethbridge	1 000 177.4	Ponoka	173 175.1	Bonnyville	67 722.9
Wheatland	576 455.2	Westlock	170 261.1	Athabasca	64 142.0
Taber	573 195.3	Spirit River	163 199.5	Pincher Creek	59 062.5
Cypress	525 765.1	Paintearth	142 829.4	Big Lakes	54 976.3
Vulcan	506 652.4	Stettler	142 129.1	City of Calgary	43 133.5
Vermilion River	475 171.6	Leduc	139 019.5	Special Area 2	35 122.5
Forty Mile	474 253.5	Lamont	138 689.6	City of Edmonton	26 741.1
Camrose	414 750.3	Northern Sunrise	138 409.0	Lac Ste. Anne	25 888.9
Kneehill	384 403.1	Lacombe	137 560.6	Thorhild	21 432.3
Rocky View	369 716.9	Cardston	136 783.3	Clear Hills	19 775.2
Flagstaff	335 358.9	Mountain View	133 737.4	Greenview	11 257.1
Grande Prairie	303 074.9	Strathcona	132 515.6	Brazeau	9 600.9
Minburn	258 766.5	Sturgeon	132 461.2	Lesser Slave River	7 266.8
Red Deer	255 499.4	Mackenzie	116 367.3	Yellowhead	5 493.9
Drumheller	249 104.6	Wetaskiwin	111 578.7	Clearwater	3 816.6
Newell	226 747.2	Barrhead	104 770.9	Saddle Hills	1 972.6
Wainwright	219 899.3	Northern Lights	100 319.3	Wood Buffalo	1 857.3
Alberta	217 799.0	Special Area 4	98 725.0	Woodlands	1 853.8
Special Area 3	214 551.0	Two Hills	92 553.7	Ranchland	1 505.1
Provost	209 716.4	Starland	90 242.9	Lac La Biche	1 417.4
Smoky River	205 250.9	Peace	88 005.5	Opportunity	144.6
Foothills	200 168.5	Parkland	80 845.7	Bighorn	68.4
Warner	196 982.6	Acadia	79 420.5	Jasper Nat. Park	13.6
Beaver	186 403.8	St. Paul	75 922.0	Banff Nat. Park	13.1
Fairview	184 409.6	Smoky Lake	74 074.6		
Willow Creek	181 238.9	Birch Hills	72 708.3		
				Total	**12 476 095.8**

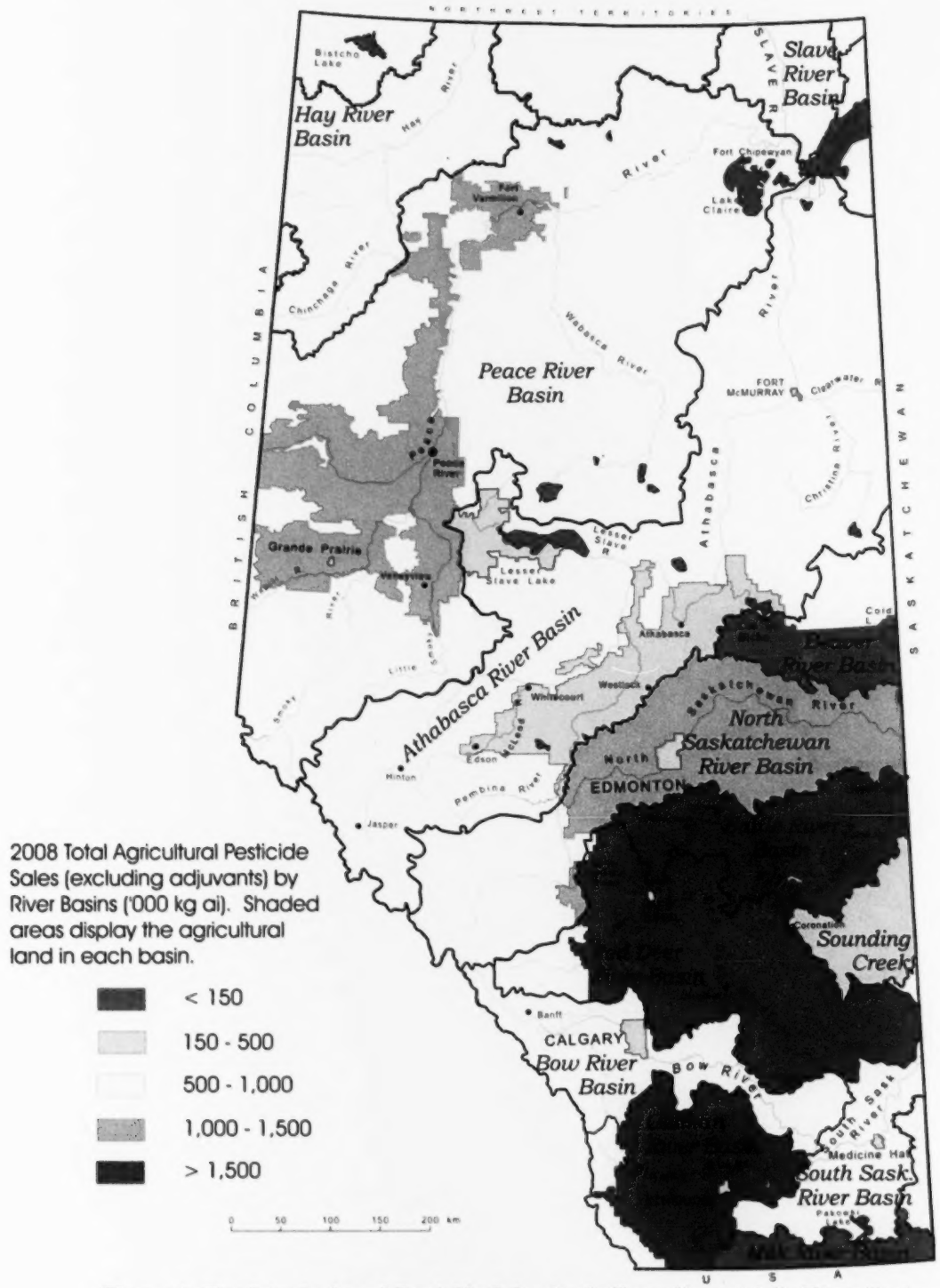

Figure 4. Total Agricultural Pesticide Sales (excluding adjuvants) By River Basin ('000 kg ai) - 2008

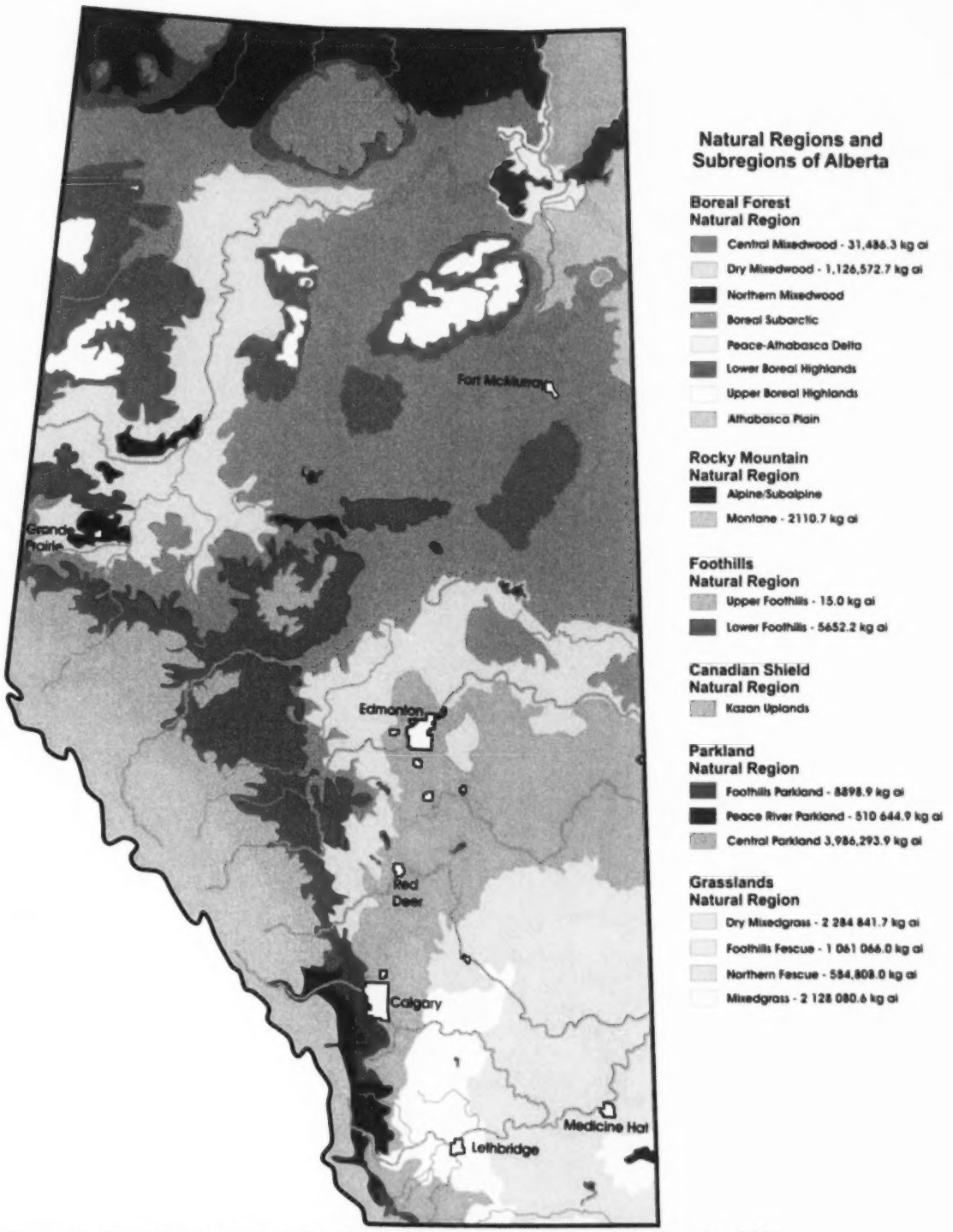

Figure 5. Total Pesticide Sales by Natural Regions and Subregions (kg ai) - 2008

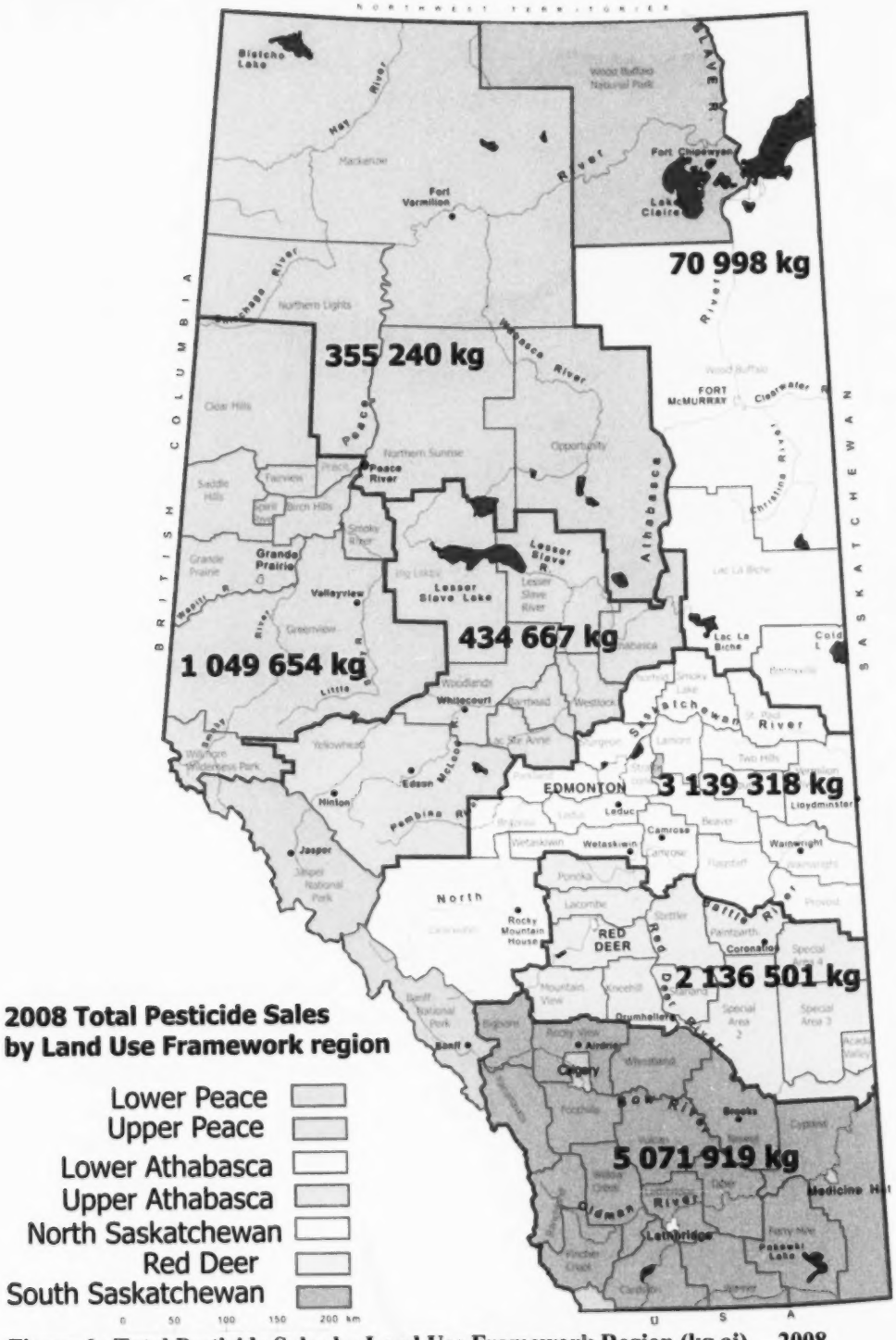

Figure 6. Total Pesticide Sales by Land Use Framework Region (kg ai) – 2008

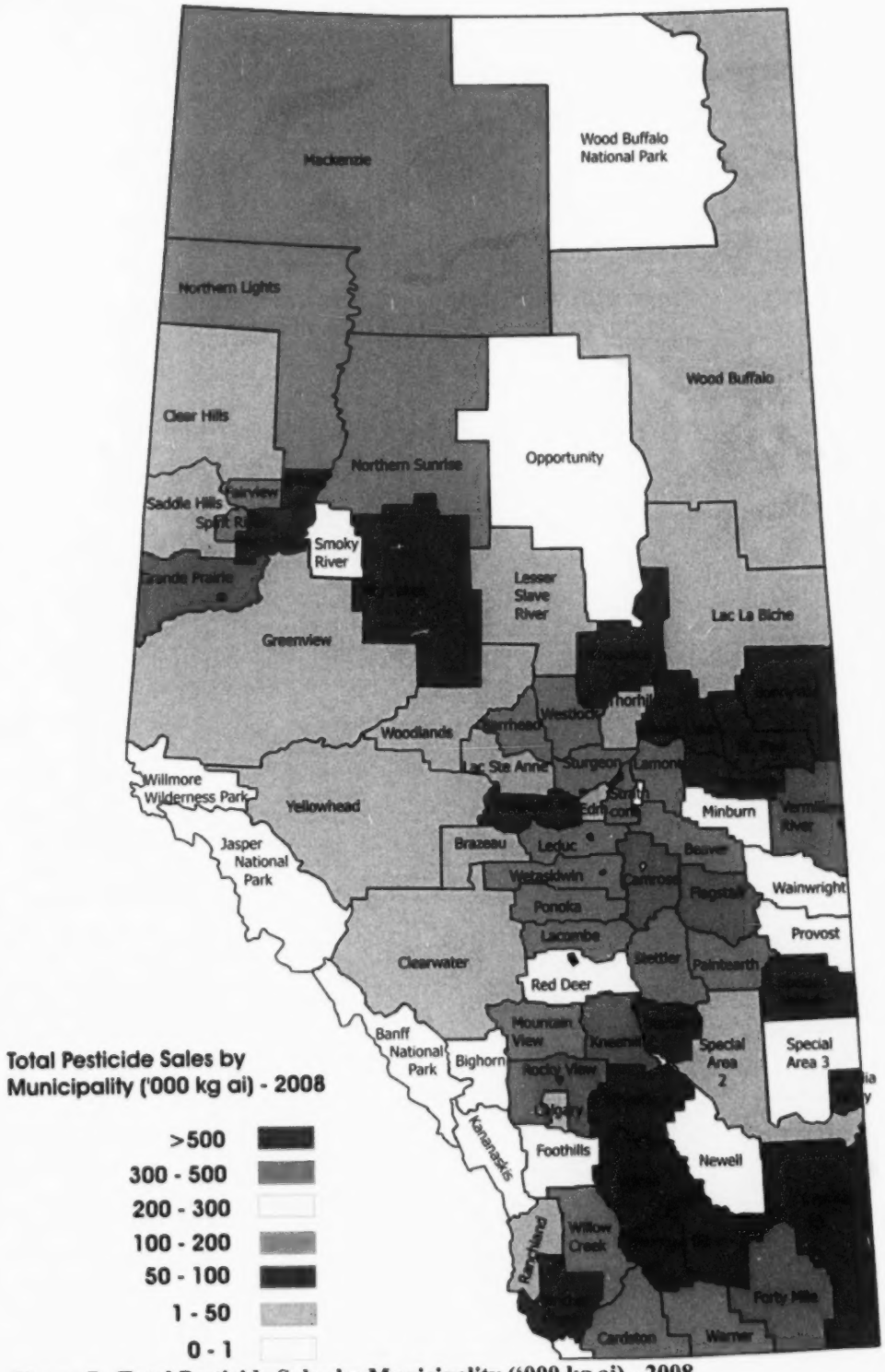

Figure 7. Total Pesticide Sales by Municipality ('000 kg ai) - 2008

4.0 DISCUSSION

4.1 Use Intensity-Alberta

The first pesticide sales survey was conducted in Alberta for the 1988 to 1993 period for agricultural products only. It was followed by a comprehensive multi-sector survey in 1998 and again in 2003. The 1988 to 1993 sales data were based upon data obtained from the major line companies operating in Alberta at the time (e.g., grain handling companies). It did not include the sales data from independent dealers, which was estimated to make up approximately half of the market at the time. In order to make the 1988 and 1993 data consistent with more recent reporting, the sales totals obtained for those two years were doubled. The 1998, 2003 and 2008 surveys include data from the line companies and independent dealers, and are more comprehensive.

Total agricultural sales for those years were determined, and correlated to cropland information obtained from the Census of Agriculture, also carried out every 5 years (Pekalski 1995, AAFRD 2002; AARD 2009) (Table 16). The timing of the Census of Agriculture (years ending in 1 and 6) and the pesticide sales survey (years ending in 3 and 8) do not match, but the closest time periods are used for comparing and calculating overall agricultural pesticide use intensity for Alberta.

Table 16. Pesticide use comparisons 1988-2008 (excluding adjuvants)

	1988	1993	1998	2003	2008
Ag Pesticide Sales (kg ai)	6 956 950*	7 491 440*	7 588 662	7 561 854	10 409 646.5
Cropland area (ha)(census survey year in brackets)	9 162 850 (1986)	9 292 374 (1991)	9,546,886 (1996)	9 728 527 (2001)	10 222 234 (2006)
Pesticide use intensity (kg/ha)	0.76	0.81	0.79	0.78	1.02

*Reported sales in 1988 and 1993 were adjusted to provide an estimated total that could be compared to other years.

Overall agricultural pesticide use intensity was relatively consistent in Alberta between 1988 and 2003, fluctuating around 0.8 kg/ha. By 2008 however, overall pesticide use intensity increased to over 1 kg/ha, an increase of over 28% from 2003, mainly a result of increased sales of glyphosate products (Table 4).

Cropland acreage used for the use intensity calculation also increased in 2008, mainly as result of including 660,000 ha of chemfallow in the total. The Statistics Canada agricultural census was

changed between 2001 and 2006 to distinguish summerfallow practices between tillage and chemfallow, or a combination of both. The chemfallow and combined tillage/chemfallow acreages were summed to arrive at the additional acreage used in 2008. This acreage was included to reflect the increased use of glyphosate as a tool for controlling weeds on fallow land.

More detailed breakdown of pesticide sales by municipality (Figure 7) and calculated use intensity (Table 14) shows that high sales areas correspond to high use areas because of cropping practices in the area. For example, higher regional pesticide use intensity occurs in municipalities where irrigation farming is important, and where crop production and crop inputs for crops such as potatoes, sugar beets, and corn are higher than most dryland agricultural areas of the province. These municipalities are also characterized by proportionally large areas of productive farmland.

4.2 Pesticide Use – Other Regions

The most recent comprehensive report on pesticide sales in Canada was compiled by Environment Canada in 2005, based on 2001-2003 sales for most provinces (Brimble et al. 2005). That information was summarized in the 2003 Alberta sales report (Byrtus 2007).

Quebec

More recent information on 2007 pesticide sales in Quebec was recently released (Gorse and Dion 2010). Quebec pesticide sales in that year amounted to 3.9 million kg of active ingredient, and the sales have been fairly consistent since reporting started in 1992 (fluctuating in the range between 3.5 and 4.1 million kg). Alberta's total pesticide sales in 2008 was 12.5 million kg of active ingredient, approximately three times that of Quebec's.

The distribution in type of use is markedly different between the two provinces (Table 17). Herbicide sales in Quebec made up only 51.1% of total sales, while Alberta's herbicide sales made up over 82%. In Alberta, sales of adjuvants associated with the high proportion of herbicide sales were also proportionately high compared to Quebec. On the other hand, sales of fungicides and insecticides were both proportionately and numerically higher in Quebec than Alberta, reflecting different pest pressures in that region of the country.

Table 17. Total Pesticide Sales by Type of Use for Alberta and Quebec

	Alberta		Quebec	
Type of Use	**2008 Kg ai**	**2008 (%)**	**2007 kg ai**	**2007 %**
Herbicides	10 253 854	82.2	1 993 480	51.1
Fungicides	388 560	3.1	860 417	22.1
Insecticides, Acaracides, Repellents	236 169	1.9	629 946	16.2
Adjuvants and Surfactants	1 580 104	12.7	128 430	3.3
Vertebrate Control Products and Vertebrate Repellents	12 458	0.1	8 871	0.2
Biocides	275	0.00	204 321	5.2
Soil Sterilants	392	0.00	59 755	1.5
Plant Growth Regulators	3449	0.03	14 569	0.4
Other	834	0.01	155	0.0
Total	**12 476 096**	**100**	**3 899 944**	**100**

Quebec uses chemical groups to report on pesticide sales instead of individual active ingredients. Their top five groups are the Phosphonic/Phosphinic acids (26.3%), Biscarbamates (14.3%), Chlorotriazines (5.9%), Phenoxy acids (5.5%), and Dithiocarbamates (4.4%). In Alberta, the top five chemical groups in sales are the Phosphonic/Phosphinic Acids (53.2%), Phenoxy acids (17.1%) Fatty Acids and Surfactants (7.4%) Hydrocarbons (5.3%) and Benzonitriles (2.9%) (Appendix 2). This comparison illustrates that the makeup of products sold in Quebec and Alberta is dominated by the Phosphonic/Phosphinic acids (primarily glyphosate). Phenoxy acids (mainly 2,4-D & MCPA) are also heavily used in both provinces. However, other than these two groups, the remaining high volume chemical groups were considerably different. Alberta's other major groups are dominated by adjuvants and surfactants, while Quebec's are dominated by fungicides (Biscarbamates) and the Chlorotriazines (e.g., atrazine), reflecting the different crops and pest pressures.

U.S.A.

Data from the U.S. for 2007 on total pesticide active ingredient usage (Grube et. al 2011) showed that herbicides made up only 47% of the U.S. pesticide market, with insecticides at 8%, fungicides at 6%, and Other products making up the remaining 39%. This report also looked at the world pesticide market breakdown for 2007, which showed herbicides making up only 40%, insecticides at 17%, fungicides at 10%, and Other products making up the remaining 33%. From this information, it is apparent that Alberta's predominately herbicide based usage is a reflection of the relatively low insect and disease pressures that Alberta experiences compared to other regions of the world.

The U.S report also provided a breakdown of pesticide use by sector. In 2007, Agriculture made up 80% of total pesticide use, Commercial and Industrial made up 12 %, and Home and Garden made up 8% of total use. Alberta's usage (Table 3) is weighted more towards the Agricultural sector (96.7%), with limited usage in the Commercial/Industrial sector, and a very small proportion (<1%) in the Domestic (Home and Garden) sector. The American data reflects a broader usage in their Commercial/Industrial sector, and their relatively higher Home and Garden usage is reflective of the large population base and a broader range of pest organisms. To put the American data in context, the total pesticide active ingredient used there in 2007 was a reported 857 million pounds (389 million kg) of active ingredient, compared to just over 12 million kg ai for Alberta.

4.3 Cropping Practices

Seeding of herbicide tolerant canola in Alberta has influenced pesticide use and pesticide use changes over the past 15 years. Prior to herbicide tolerant canola coming onto the market, a wide spectrum of herbicides was required to control various broadleaf and grassy weeds in canola. Herbicide tolerant canola allowed full spectrum weed control with a single product (primarily glyphosate, although glufosinate and the imidazolinones such as imazethapyr, imazamox, and imazapyr have found niches). The Canola Council of Canada has compiled data from 1995 to 2010 to compare the Canadian cropping information on canola varieties from a number of sources (Canola Council 2010). It is assumed to be representative of Alberta cropping trends. The start date of 1995 reflects the period before herbicide tolerant varieties came onto the market, and the subsequent shifts towards Roundup Ready (glyphosate tolerant - transgenic), Liberty (glufosinate tolerant – transgenic) and Clearfield (imidazolinone tolerant – not transgenic) up to and including 2010.

In 1995 conventional canola accounted for 100% of total seeded canola acres (Figure 8) in Canada. By 1998 it accounted for only 49%, whereas by 2003 it accounted for only 12% of seeded acres. The Clearfield varieties started coming onto the market in 1996, peaking in 2000 at 25% and dropping to 13% by 2008. Glyphosate and glufosinate tolerant varieties also came onto the market in 1996, and both types have increased in use over the years. By 2008, conventional varieties of canola had virtually dropped out of the marketplace (1%), while glyphosate tolerant varieties made up 45% of the acreage seed, and glufosinate tolerant varieties made up 41%. Total canola acreage harvested in Alberta fluctuated from year to year between 1996 and 2008, from

1.7 million acres to almost 5.2 million acres (Table 18)(Alberta Canola Producers Commission 2003 and 2009).

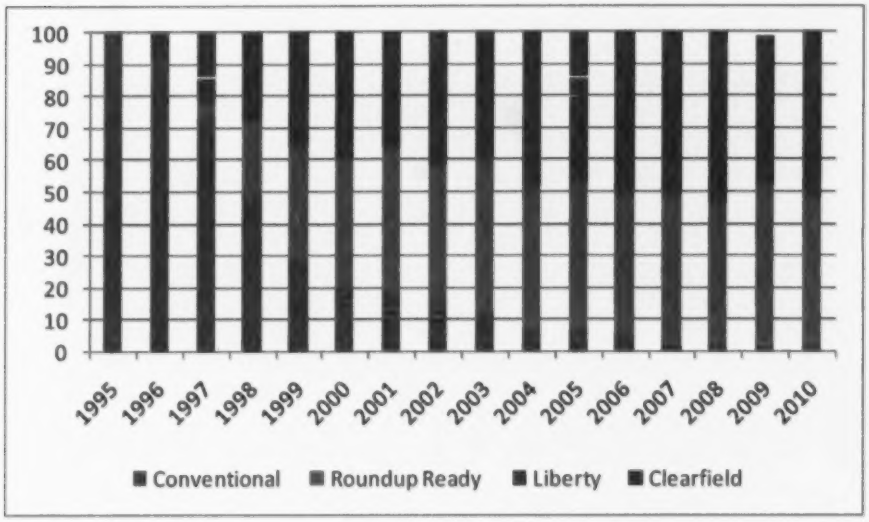

Figure 8. Canadian Canola Varieties – Percentage of Seeded Acres (1995-2010)

Table 18. Canola total acres harvested ('000's)

	Acres harvested ('000 acres)
1996	3 000
1997	3 950
1998	4 300
1999	4 520
2000	3 800
2001	2 850
2002	1 700
2003	3 300
2004	3 800
2005	4 250
2006	4 480
2007	4 460
2008	5 170

Agricultural pesticide sales data reflect the changes in products used on herbicide tolerant canola (Figure 9). Pre-emergent herbicides used primarily on conventional canola, but also on other crops (i.e., triallate, ethalfluralin and trifluralin) have dropped in sales volume over the past 20 years, related in large part to the shift in herbicide tolerant canola varieties being seeded. Triallate dropped from 693 178 kg ai in 1998 to 101 072 kg ai by 2008, with ethalfluralin and

trifluralin showing similar reductions. On the other hand, glyphosate increased significantly each reporting period, going from 2.7 million kg ai in 1998 to 6.1 million kg ai by 2008 (Appendix 2).

While not all of the glyphosate sales can be directly attributed to changes in canola cropping practices, the shift to glyphosate tolerant canola has had a major influence on glyphosate usage. In addition to glyphosate tolerant canola influencing glyphosate sales, producers also adopted zero-tillage practices throughout the 1990's and 2000's, using glyphosate for pre-seeding weed control instead of tillage. Additionally, some of the increase in glyphosate use can be attributed to other changes in farming practices such as the decline in tillage in favour of 'chemfallow', and the use of glyphosate for in-crop weed control prior to harvest.

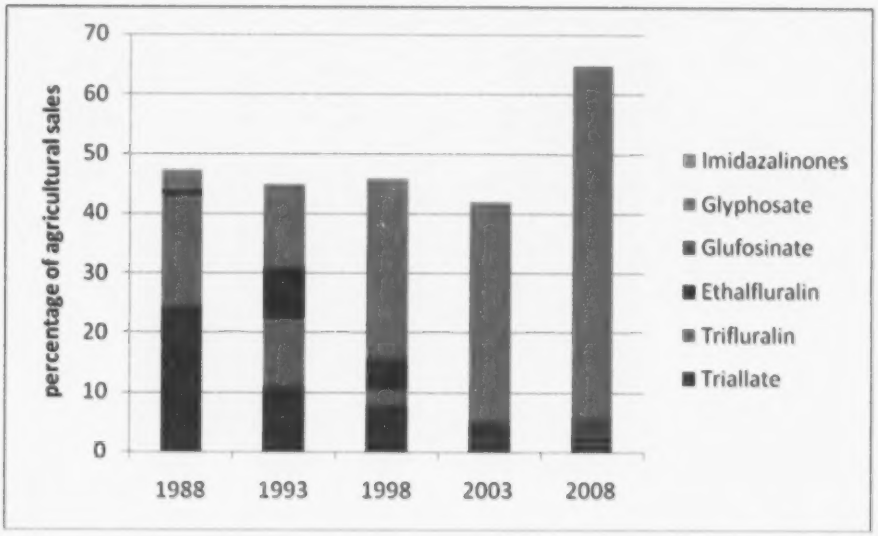

Figure 9. Selected Canola Herbicide Sales (1988-2008)

4.4 Agricultural Insecticides

Agricultural insecticide use fluctuates considerably from year to year. Insect outbreaks characterized 1998 (Lygus bug) and 2003 (grasshopper) insecticide sales. Insect pest pressures were considerably less in 2008.

In 2008, insecticides accounted for only 1.6%% of all agricultural use, and chlorpyrifos made up 44% of that volume. Chlorpyrifos and carbaryl were the two insecticides with the largest sales in 2003. However, chlorpyrifos sales dropped from 197 765 kg ai in 2003 to 82 729 kg ai in 2008. Carbaryl sales dropped from 104 430 kg ai in 2003 to 9787 kg ai in 2008.

In 1998, high sales volumes of chlorpyrifos (217 397 kg ai) were also reported because of an outbreak of Lygus bug which required spraying of 1.4 M acres for this pest species (Byrtus 2000).

4.5 Spatial Data

The pesticide sales data was sorted in a number of ways to provide some spatial perspective. The spatial sorts were done by municipality, by natural region, by Land Use Framework region, and by drainage basin. The municipality level was the highest level of resolution attempted, with over 60 polygons involved. Problems in interpreting data at this scale are that vendors are not evenly distributed amongst municipalities, with some major distribution centres (e.g., Lethbridge, Medicine Hat) influencing some of the spatial interpretation of the data.

At the river basin scale, there are fewer polygons involved, resulting in slightly better confidence in the spatial assessment. For water quality monitoring purposes, the breakdown of pesticide sales by river basin is a useful tool in determining monitoring priorities. A detailed breakdown on pesticide sales by active ingredient and river basin is outlined in Appendix 4

Changes in pesticide sales were consistent over most of the geographical areas between 2003 and 2008, with most comparable areas going up in sales. The Land Use Framework regions are a new regional context to assess pesticide sales, and with 82% of total pesticide sales in three of the seven regions (North Saskatchewan, Red Deer, and South Saskatchewan), this reflects on the large amount of agricultural inputs used in this part of the province.

5.0 CONCLUSIONS

The overview of 2008 pesticide sales data provides a general background for assessing pesticide management programs and pesticide monitoring programs. Product breakdowns and regional distributions are comparable to results observed in 2003, although increasing utilization of the active ingredient glyphosate was again observed, similar to the observation made in 2003.

Key results of the 2008 survey are:

- Total sales volume was almost **12.5** million kg of active ingredient.
- Herbicides and plant growth regulators made up **82.2%** of the total volume sold.
- Of the chemical groups, the Phosphonic/Phosphinic Acid group had the highest sales, comprising **53.2%** of total pesticide sales.
- From this chemical group, glyphosate sales accounted for **6.2** million kg ai, 50% of total sales and an 84% increase over 2003.
- The Agriculture sector accounted for **96.5%** of all pesticides sold in Alberta, with 82% of that being herbicides, and 3% being fungicides.
- The Commercial/Industrial sector accounted for **3.1%** of all pesticides sold in Alberta, with herbicides making up 90% and fungicides 5%.
- The Domestic sector accounted for **0.7%** of total pesticide sales, with herbicides making up 68% and insecticides 27.5%.
- Spatially, the Oldman, Red Deer, North Saskatchewan, Battle and Peace River basins each had over **1** million kg ai of pesticide sales.
- The South Saskatchewan River Land Use Framework region had the highest proportion of pesticide sales at over **40%**. The Lower Athabasca region had the lowest proportion of sales at **0.6%** of pesticide sales.
- The Central Parkland natural region had the largest volume of sales by natural region, at just under **4** million kg ai.
- Average agricultural pesticide use intensity for Alberta was estimated at **1.02** kg ai/ha.

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Appendix 1. Chemical Groups and Active Ingredients - 2008

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Acylureas	BENTAZON	Herbicide
	BROMACIL	Herbicide
	DIFLUBENZURON	Insecticide
	HEXAZINONE	Herbicide
	IPRODIONE	Fungicide
	TERBACIL	Herbicide
Alcohols	BUTOXYPOLYPROPYLENE GLYCOL	Insecticide
	CHOLECALCIFEROL	Vertebrate
	P-MENTHANE-3, 8-DIOL	Insecticide
	SILOXYLATED POLYETHER	Adjuvant
Aldehydes	FORMALDEHYDE	Fungicide
	METALDEHYDE	Insecticide
Amides	CAPSAICIN (OLEORESIN CAPSICUM)	Vertebrate
	DAMINOZIDE	Plant Growth Regulator
	NAPROPAMIDE	Herbicide
	PIPERINE	Vertebrate
Ammoniums, Quaternary	CHLORMEQUAT	Plant Growth Regulator
	DENATONIUM BENZOATE	Vertebrate
	DIDECYL DIMETHYL AMMONIUM CHLORIDE	Disinfectant
	DIFENZOQUAT	Herbicide
	DIQUAT	Herbicide
	N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Disinfectant
	PARAQUAT	Herbicide
Anilides	BOSCALID	Fungicide
	FENHEXAMID	Fungicide
	METALAXYL	Fungicide
	METALAXYL-M	Fungicide
	PROPANIL	Herbicide
	S-METOLACHLOR	Herbicide
Aryloxyphenoxyl Acids	CLODINAFOP-PROPARGYL	Herbicide
	DICLOFOP-METHYL	Herbicide
	FENOXAPROP-P-ETHYL (ISOMER)	Herbicide
	FLUAZIFOP-P-BUTYL	Herbicide
	QUIZALOFOP P-ETHYL	Herbicide
	QUIZALOFOP-ETHYL	Herbicide
Azoles, Oxazoles, Thiazoles	ETRIDIAZOLE	Fungicide
	FLUDIOXONIL	Fungicide
	PINOXADEN	Herbicide
	PYRASULFOTOLE	Herbicide
	SPIROTETRAMAT	Insecticide
	STRYCHNINE	Vertebrate
	THIABENDAZOLE	Fungicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Benzamides	DEET	Insecticide
	ISOXABEN	Herbicide
	PROPYZAMIDE	Herbicide
	TEBUFENOZIDE	Insecticide
Benzoic Acid & Derivatives	DICAMBA	Herbicide
	OXINE BENZOATE	Fungicide
	QUINCLORAC	Herbicide
Benzonitriles	BROMOXYNIL	Herbicide
	CHLOROTHALONIL	Fungicide
	DICHLOBENIL	Herbicide
Biscarbamates	DESMEDIPHAM	Herbicide
	FERBAM	Fungicide
	MANCOZEB	Fungicide
	MANEB	Fungicide
	METIRAM	Fungicide
	PHENMEDIPHAM	Herbicide
	THIOPHANATE-METHYL	Fungicide
	THIRAM	Fungicide
	ZINEB	Fungicide
Carbamates	BENDIOCARB	Insecticide
	BIFENAZATE	Insecticide
	CARBARYL	Insecticide
	CARBOFURAN	Insecticide
	CHLORPROPHAM	Herbicide
	OXADIAZON	Herbicide
	PROPAMOCARB HYDROCHLORIDE	Fungicide
	PROPOXUR	Insecticide
	VINCLOZOLIN	Fungicide
Chlorotriazines	ATRAZINE	Herbicide
	PYMETROZINE	Insecticide
	SIMAZINE	Herbicide
Chromenones	BRODIFACOUM	Vertebrate
	BROMADIOLONE	Vertebrate
	DIFETHIALONE	Vertebrate
	ROTENONE	Insecticide
	WARFARIN	Vertebrate
Cyclohexanedione oximes	CLETHODIM	Herbicide
	SETHOXYDIM	Herbicide
	TEPRALOXYDIM	Herbicide
	TRALKOXYDIM	Herbicide
Diazines	ANCYMIDOL	Plant Growth Regulator
	MALEIC HYDRAZIDE	Plant Growth Regulator
	PYRAZON	Herbicide
	PYRIDABEN	Insecticide
	SULFAQUINOXALINE	Vertebrate

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Dinitrobenzenes	BROMETHALIN	Vertebrate
	ETHALFLURALIN	Herbicide
	PENDIMETHALIN	Herbicide
	TRIFLURALIN	Herbicide
Dithiocarbamates	DAZOMET	Soil
Dithiophosphates	AZINPHOS-METHYL	Insecticide
	DIMETHOATE	Insecticide
	MALATHION	Insecticide
	PHORATE	Insecticide
	PHOSALONE	Insecticide
	PHOSMET	Insecticide
	TERBUFOS	Insecticide
Fatty Acids & Surfactants	FATTY ACID	Herbicide
	METHYLATED CANOLA OIL	Adjuvant
	NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant
	PARAFFIN BASE PETROLEUM OIL	Adjuvant
	POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant
	POTASSIUM SALTS OF FATTY ACIDS	Insecticide
	SAFER'S INSECTICIDAL SOAP	Insecticide
	SOAP (INSECTICIDAL)	Insecticide
	SOAP (HERBICIDAL)	Herbicide
	SURFACTANT BLEND	Adjuvant
	SURFACTANT MIXTURE	Adjuvant
Guanidines	CLOTHIANIDIN	Insecticide
	CYPRODINIL	Fungicide
	HYDRAMETHYLNON	Insecticide
	IMIDACLOPRID	Insecticide
	THIAMETHOXAM	Insecticide
Halogenated Organic Acids	AMINOPYRALID	Herbicide
	CLOPYRALID	Herbicide
	PICLORAM	Herbicide
Hydrocarbons	ASPHALT SOLIDS	Fungicide
	NAPHTHALENE	Insecticide
	PETROLEUM HYDROCARBON BLEND	Adjuvant
Imidazolinones	FENAMIDONE	Fungicide
	IMAZAMETHABENZ	Herbicide
	IMAZAMOX	Herbicide
	IMAZETHAPYR	Herbicide
	IMAZAPYR	Herbicide
Indanediones	CHLOROPHACINONE	Vertebrate
	DIPHACINONE	Vertebrate
Inorganic Coppers	COPPER (CUPRIC) HYDROXIDE	Fungicide
	COPPER NAPHTHENATE	Wood

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	COPPER OXYCHLORIDE	Fungicide
	COPPER SULPHATE	Fungicide
	COPPER SULPHATE TRIBASIC	Fungicide
Inorganic Zincs	ZINC NAPHTHENATE	Wood
	ZINC PHOSPHIDE	Vertebrate
Inorganics, Other	ALUMINUM PHOSPHIDE	Insecticide
	AMMONIA	Vertebrate
	BORACIC ACID	Insecticide
	BORAX	Insecticide
	FERRIC PHOSPHATE	Insecticide
	FERROUS SULFATE	Herbicide
	FOSETYL-AL	Fungicide
	LIME SULPHUR	Fungicide
	POTASSIUM MONOPERSULPHATE	Disinfectant
	SILICA AEROGEL	Insecticide
	SILICON DIOXIDE FRESH WATER FOSSILS	Insecticide
	SILICON DIOXIDE SALT WATER FOSSILS	Insecticide
	SULPHUR (FUNGICIDE)	Fungicide
	SULPHUR (INSECTICIDE)	Insecticide
	SULPHUR (VERTEBRATE CONTROL)	Vertebrate
Methoxyacrylates	AZOXYSTROBIN	Fungicide
	PYRACLOSTROBIN	Fungicide
	TRIFLOXYSTROBIN	Fungicide
Microbials	*BACILLUS SPHAERICUS*	Insecticide
	BACILLUS SUBTILIS	Insecticide
	BACILLUS THURINGIENSIS SSP KURSTAKI	Insecticide
	BACILLUS THURINGIENSIS, SEROTYPE H-14	Insecticide
	GLIOCLADIUM CATENULATUM	Fungicide
	STREPTOMYCES GRISEOVIRIDIS	Fungicide
	STREPTOMYCES LYDICUS	Fungicide
Miscellaneous (Non-Classified)	1-OCTEN-3-OL	Insecticide
	ACROLEIN	Herbicide
	BISPYRIBAC	Herbicide
	BRONOPOL	Preservative
	CORN GLUTEN MEAL	Herbicide
	DRIED BLOOD	Vertebrate
	ETHOFUMESATE	Herbicide
	METHYL NONYL KETONE	Vertebrate
	NATURAL GUM RESINS	Insecticide
	PIPERONYL BUTOXIDE	Insecticide
	PUTRESCENT WHOLE EGG SOLIDS	Vertebrate
	SODIUM ALPHA-OLEFIN SULFONATE	Adjuvant
	WATER SOLUBLE DYES	Herbicide
Morpholines & Oxathiines	CARBATHIIN	Fungicide
	DIMETHOMORPH	Fungicide
	DODEMORPH-ACETATE	Fungicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	OXYCARBOXIN	Fungicide
Nitrobenzenes	MESOTRIONE	Fungicide
	OXYFLUORFEN	Herbicide
	QUINTOZENE	Fungicide
Oils, Mineral and Vegetable	ARTIFICIAL ESSENTIAL OIL BLEND	Insecticide
	MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide
	OIL OF BLACK PEPPER	Vertebrate
Organic Acids	ABAMECTIN	Insecticide
	ACEQUINOCYL	Insecticide
	ACETIC ACID	Herbicide
	FERRIC SODIUM EDTA	Insecticide
	GIBBERELLIC ACID	Plant Growth Regulator
	SPINETORAM	Insecticide
	SPINOSAD FACTOR A PLUS	Insecticide
	SPIROMESIFEN	Insecticide
	TRINEXAPAC-ETHYL	Plant Growth Regulator
Organochlorines	DICOFOL	Insecticide
	ENDOSULFAN	Insecticide
	PARADICHLOROBENZENE	Insecticide
Organohalogens	METHYL BROMIDE	Insecticide
Organometallics	FENBUTATIN OXIDE	Insecticide
Oximes-Carbamates	METHOMYL	Insecticide
	OXAMYL	Insecticide
Phenoxy Acids	2,4-D	Herbicide
	2,4-DB	Herbicide
	4-CPA	Plant Growth Regulator
	DICHLORPROP (2,4-DP)	Herbicide
	MCPA	Herbicide
	MCPB	Herbicide
	MECOPROP (D-ISOMER)	Herbicide
	MECOPROP-P	Herbicide
	TRICLOPYR	Herbicide
Pheromones	GERMAN COCKROACH EXTRACT	Insecticide
	KINOPRENE	Insecticide
	METHOPRENE	Insecticide
	Z-9-TRICOSENE	Insecticide
Phosphates	DICHLORVOS	Insecticide
	NALED	Insecticide
Phosphonic Acids, Phosphinic Acids	ETHEPHON	Plant Growth Regulator
	GLUFOSINATE AMMONIUM	Herbicide
	GLYPHOSATE	Herbicide
Phosphoramidothioates	ACEPHATE	Insecticide
	METHAMIDOPHOS	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	PROPETAMPHOS	Insecticide
Phthalic Acids	CAPTAN	Fungicide
	FOLPET	Fungicide
	N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide
	PROTHIOCONAZOLE	Fungicide
Pyrethroids, Pyrethrins	CYFLUTHRIN	Insecticide
	CYHALOTHRIN-LAMBDA	Insecticide
	CYPERMETHRIN	Insecticide
	D-CIS ALLETHRIN	Insecticide
	D-CIS, TRANS ALLETHRIN	Insecticide
	DELTAMETHRIN	Insecticide
	D-PHENOTHRIN	Insecticide
	D-TRANS ALLETHRIN	Insecticide
	PERMETHRIN	Insecticide
	PYRETHRINS	Insecticide
	RESMETHRIN	Insecticide
	TETRAMETHRIN	Insecticide
Pyridines	4-AMINOPYRIDINE	Vertebrate
	ACETAMIPRID	Insecticide
	DI-N-PROPYL ISOCINCHOMERONATE	Insecticide
	FLUROXYPYR 1-METHYLHEPTYL ESTER	Herbicide
	NICOTINE	Insecticide
	PYRIPROXYFEN	Insecticide
Sulfonylureas	CHLORSULFURON	Herbicide
	ETHAMETSULFURON-METHYL	Herbicide
	FLUCARBAZONE SODIUM	Herbicide
	METSULFURON-METHYL	Herbicide
	NICOSULFURON	Herbicide
	RIMSULFURON	Herbicide
	SULFOSULFURON	Herbicide
	THIFENSULFURON METHYL	Herbicide
	TRIASULFURON	Herbicide
	TRIBENURON METHYL	Herbicide
	TRIFLUSULFURON METHYL	Herbicide
Thiocarbamates	EPTC	Herbicide
	TRIALLATE	Herbicide
Thiophosphates	CHLORPYRIFOS	Insecticide
	DIAZINON	Insecticide
	FENTHION	Insecticide
Triazines, Tetrazines	CYROMAZINE	Insecticide
	METRIBUZIN	Herbicide
	PROMETRYNE	Herbicide
Triazoles	AMITROLE	Herbicide
	DIFENOCONAZOLE	Fungicide
	FLORASULAM	Herbicide
	MYCLOBUTANIL	Fungicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	PACLOBUTRAZOL	Plant Growth Regulator
	PROPICONAZOLE	Fungicide
	PYROXSULAM	Herbicide
	TEBUCONAZOLE	Fungicide
	TRITICONAZOLE	Fungicide
	UNICONAZOLE-P	Plant Growth Regulator
Urea Derivatives	CARFENTRAZONE-ETHYL	Herbicide
	DIURON	Herbicide
	LINURON	Herbicide

Appendix 2. Alberta (2008) and Quebec (2007) Pesticide Sales by Chemical Group

Active Ingredient	Alberta kg ai	%	Quebec kg ai	%
Phosphonic Acids, Phosphinic Acids	6 633 567.6	53.2	1 025 632	26.3
Phenoxy Acids	2 130 654.7	17.1	212 920	5.5
Fatty Acids & Surfactants	924 680.7	7.4	147 748	3.8
Hydrocarbons	659 521.1	5.3	168 565	4.3
Benzonitriles	366 443.3	2.9	107 246	2.7
Cyclohexanedione oximes	191 948.1	1.5	2 702	0.1
Dinitrobenzenes	118 607.6	1.0	34 270	0.9
Thiocarbamates	112 096.2	0.9	9 848	0.3
Imidazolinones	111 806.9	0.9	5 862	0.2
Aryloxyphenoxyl Acids	110 792.2	0.9	5 512	0.1
Triazoles	104 706.9	0.8	4 557	0.1
Biscarbamates	102 813.6	0.8	557 420	14.3
Benzoic Acid & Derivatives	94 908.1	0.8	36 970	0.9
Halogenated Organic Acids	88 074.6	0.7	14 739	0.4
Acylureas	85 612.4	0.7	58 336	1.5
Thiophosphates	85 271.0	0.7	27 638	0.7
Pyridines	72 411.4	0.6	999	0.0
Inorganics, Other	64 911.7	0.5	137 419	3.5
Dithiophosphates	57 202.3	0.5	38 225	1.0
Urea Derivatives	47 686.2	0.4	29 489	0.8
Azoles, Oxazoles, Thiazoles	41 280.5	0.3	51 580	1.3
Ammoniums, Quaternary	40 722.8	0.3	39 826	1.0
Sulfonylureas	27 844.2	0.2	9 030	0.2
Phthalic Acids	27 137.5	0.2	80 919	2.1
Anilides	26 918.2	0.2	152 662	3.9
Methoxyacrylates	20 532.1	0.2	4 409	0.1
Miscellaneous (Non-Classified)	18 881.7	0.2	118 743	3.0
Carbamates	15 688.9	0.13	31 246	0.8
Morpholines & Oxathiines	15 453.0	0.12	7 735	0.2
Organic Acids	12 048.4	0.10	3 887	0.1
Chlorotriazines	10 953.3	0.09	230 358	5.9
Nitrobenzenes	7 627.0	0.06	31 391	0.8
Guanidines	6 849.5	0.05	9 446	0.2
Organohalogens	6 106.3	0.05	2 294	0.1
Triazines, Tetrazines	5 919.3	0.05	9 571	0.2
Alcohols	5 853.1	0.05	5 471	0.1
Pyrethroids, Pyrethrins	5 717.9	0.05	9 552	0.2
Inorganic Coppers	4 141.5	0.03		
Oils, Mineral and Vegetable	3 925.8	0.03	156 784	4.0
Benzamides	1 694.3	0.01	77 649	2.0
Diazines	1 291.1	0.01	11 730	0.3
Pheremones	1 274.0	0.01	8	0.00
Phosphates	1 077.6	0.01	5 266	0.1
Organochlorines	830.3	0.01	23 183	0.6

Phosphoramidothioates	626.2	0.01	5 110	0.1
Aldehydes	569.4	0.00	7 955	0.2
Microbials	420.4	0.00	2 914	0.1
Dithiocarbamates	392.0	0.00	171 526	4.4
Amides	270.9	0.00	7956	0.2
Inorganic Zincs	179.8	0.00		
Chromenones	61.9	0.00	163	0.00
Oximes-Carbamates	57.2	0.00	4 955	0.1
Indanediones	24.6	0.00	6	0.00
Organometallics	8.6	0.00	17	0.00
Anilines	0.0	0.00	499	0.01
Total	**12 476 095.8**	**100.0**	**3 899 944**	**100.0**

Appendix 3. Alberta 1998, 2003 and 2008 Pesticide Sales by Active Ingredient

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
GLYPHOSATE	Herbicide	6 235 498.5	50.0	3 419 822.1	36.9	2 682 748.9
MCPA	Herbicide	1 028 995.8	8.2	1 097 359.0	11.8	885 239.1
2,4-D	Herbicide	973 082.3	7.8	763 357.7	8.2	765 820.4
PETROLEUM HYDROCARBON BLEND	Adjuvant	656 588.2	5.3	559 728.7	6	368 704.3
SURFACTANT BLEND	Adjuvant	403 438.3	3.2	438 235.7	4.7	496 561.7
GLUFOSINATE AMMONIUM	Herbicide	395 681.1	3.2	107 255.5	1.2	63 863.8
BROMOXYNIL	Herbicide	330 177.1	2.6	354 906.6	3.8	268 105.3
PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant	188 738.7	1.5	192 634.4	2.1	193 162.6
METHYLATED CANOLA OIL	Adjuvant	187 385.6	1.5			
TRALKOXYDIM	Herbicide	147 916.9	1.2	141 226.1	1.5	126 323.5
TRIALLATE	Herbicide	101 072.2	0.8	197 221.4	2.1	693 178.5
DICAMBA	Herbicide	94 677.9	0.8	121 422.7	1.3	138 278.6
IMAZAMETHABENZ	Herbicide	94 004.3	0.8	138 551.4	1.5	173 679.2
ETHALFLURALIN	Herbicide	82 873.7	0.7	168 135.0	1.8	452 294.4
CHLORPYRIFOS	Insecticide	82 728.7	0.7	197 765.5	2.1	217 397.5
THIRAM	Fungicide	76 081.8	0.6	27 136.3	0.29	22 791.7
FLUROXYPYR	Herbicide	71 814.1	0.6	43 166.7	0.47	23 700.8
NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	58 634.2	0.5	59 558.8	0.64	94 247.3
FENOXAPROP-P-ETHYL	Herbicide	58 399.7	0.5	64 212.1	0.69	59 919.0
CLOPYRALID	Herbicide	58 339.1	0.5	56 618.0	0.61	59 019.7
IPRODIONE	Fungicide	57 374.1	0.5	21 014.3	0.23	9 592.7
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant	55 943.9	0.4	13 727.9	0.15	9 340.0
DICHLORPROP	Herbicide	52 271.6	0.4	57 450.1	0.62	40 942.4
PROPICONAZOLE	Fungicide	50 387.5	0.4	13 183.4	0.14	5 664.4
CLODINAFOP-PROPARGYL	Herbicide	46 882.3	0.4	49 520.8	0.53	34 408.9
MECOPROP-P	Herbicide	43 319.9	0.3			
PHORATE	Insecticide	40 375.5	0.3	41 417.3	0.45	19 209.0
DIURON	Herbicide	37 674.4	0.3	31 096.3	0.34	9 919.3
CHLOROTHALONIL	Fungicide	35 693.8	0.3	43 208.6	0.47	37 334.0
DIQUAT	Herbicide	34 893.9	0.3	25 524.4	0.28	21 765.0
TRIFLURALIN	Herbicide	34 730.5	0.3	40 654.3	0.44	230 028.2
PINOXADEN	Herbicide	32 783.2	0.3			
PROTHIOCONAZOLE	Fungicide	26 517.0	0.2			
TRICLOPYR	Herbicide	25 678.1	0.2	33 116.2	0.36	30 311.8
SILICA AEROGEL	Insecticide	25 090.8	0.2	7 785.0	0.08	11 052.5

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
PARAFFIN BASE PETROLEUM OIL	Adjuvant	22 939.3	0.2	27 958.4	0.3	77 427.2
MANCOZEB	Fungicide	22 355.4	0.2	36 127.2	0.39	45 813.9
BOSCALID	Fungicide	20 519.8	0.2			
BENTAZON	Herbicide	20 481.0	0.2	21 986.9	0.24	12 066.2
CLETHODIM	Herbicide	19 955.8	0.2	3 694.9	0.04	2 490.7
SETHOXYDIM	Herbicide	19 194.1	0.2	30 993.1	0.33	58 678.5
PICLORAM	Herbicide	25 377.1	0.2	17 897.0	0.19	15 109.4
FLORASULAM	Herbicide	15 760.4	0.1	6 090.5	0.07	
SILICON DIOXIDE SALT WATER FOSSILS	Insecticide	15 624.1	0.1	15 588.2	0.17	47 025.2
TEBUCONAZOLE	Fungicide	15 549.0	0.1	5 922.4	0.06	
CARBATHIIN	Fungicide	15 231.1	0.1	45 228.3	0.49	122 292.0
DIFENOCONAZOLE	Fungicide	13 599.3	0.1	11 067.6	0.12	
MALATHION	Insecticide	13 477.1	0.1	17 413.8	0.19	22 316.5
ACETIC ACID	Herbicide	11 915.6	0.10	1 555.5	0.02	
SULPHUR (VERTEBRATE CONTROL)	Rodenticide	11 404.8	0.09	185.4	0	1 045.3
EPTC	Herbicide	11 024.0	0.09	11 944.0	0.13	38 574.2
TRIBENURON METHYL	Herbicide	9 956.1	0.08	5 404.8	0.06	6 763.6
CARBARYL	Insecticide	9 787.3	0.08	104 430.6	1.1	3 142.8
ACROLEIN	Herbicide	9 051.0	0.07	16 981.4	0.18	17 520.5
THIFENSULFURON METHYL	Herbicide	8 344.1	0.07	8 572.3	0.09	13 697.5
FLUCARBAZONE SODIUM	Herbicide	8 333.0	0.07	2 292.2	0.02	
TRIFLOXYSTROBIN	Fungicide	7 982.0	0.06			
FERROUS SULFATE	Herbicide	7 846.5	0.06	1 593.4	0.02	1 818.7
IMAZAMOX	Herbicide	7 773.9	0.06	3 122.0	0.03	4 231.8
PYRACLOSTROBIN	Fungicide	7 650.5	0.06	1 263.6	0.01	
QUINTOZENE	Fungicide	7 528.8	0.06	7 166.5	0.08	9 808.9
LINURON	Herbicide	7 317.5	0.06	8 991.4	0.1	8754
ETHOFUMESATE	Herbicide	6 518.4	0.05	7 742.4	0.08	12 559.4
PYRASULFOTOLE	Herbicide	6 323.6	0.05			
IMAZETHAPYR	Herbicide	6 195.7	0.05	5 063.2	0.05	10 528.6
ATRAZINE	Herbicide	6 172.7	0.05	4 654.5	0.05	5 753.8
METHYL BROMIDE	Insecticide	6 106.3	0.05			
THIAMETHOXAM	Insecticide	5 513.7	0.04	1 176.2	0.01	
METRIBUZIN	Herbicide	5 061.1	0.04	6 306.3	0.07	7 601.4
VINCLOZOLIN	Fungicide	4 995.0	0.04	24 324.3	0.26	25 823.1
AMITROLE	Herbicide	4 994.4	0.04	2 107.0	0.02	2 026.5
AZOXYSTROBIN	Fungicide	4 899.6	0.04	1 961.1	0.02	
TEPRALOXYDIM	Herbicide	4 881.3	0.04			
SIMAZINE	Herbicide	4 725.1	0.04	1 160.4	0.01	3 688.1

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
AMINOPYRALID	Herbicide	4 358.4	0.03			
METALAXYL-M	Fungicide	4 357.1	0.03	29 813.1	0.32	
BUTOXYPOLYPROPYLENE GLYCOL	Insecticide	4 161.6	0.03	370.2	0	2.3
OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	3 920.6	0.03	5 144.7	0.06	9 219.0
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide	3 897.7	0.03	2 233.7	0.02	3 477.4
IMAZAPYR	Herbicide	3 828.1	0.03	1 710.0	0.02	200.6
DIFENZOQUAT	Herbicide	3 792.0	0.03	4 464.0	0.05	9 585.5
QUIZALOFOP P-ETHYL	Herbicide	3 673.0	0.03	4 461.0	0.05	2 669.7
2,4-DB	Herbicide	3 640.0	0.03	11 501.4	0.12	20 950.3
HEXAZINONE	Herbicide	3 540.2	0.03	940.9	0.01	2 428.1
MECOPROP-D	Herbicide	3271.0	0.03	26 080.4	0.28	27 264.1
COPPER (CUPRIC) HYDROXIDE	Fungicide	3 192.6	0.03	6 885.0	0.07	252.5
TRITICONAZOLE	Fungicide	3 145.2	0.03	2 080.4	0.02	
CYHALOTHRIN-LAMBDA	Insecticide	2 947.5	0.02	5 124.4	0.06	1 097.9
CARFENTRAZONE-ETHYL	Herbicide	2 694.4	0.02			
DIAZINON	Insecticide	2 541.5	0.02	5 149.9	0.06	4 087.3
BROMACIL	Herbicide	2 486.9	0.02	4 770.3	0.05	3 106.9
ETHEPHON	Fungicide	2 388.0	0.02	115.2	0	31.2
NAPHTHALENE	Insecticide	2 318.2	0.02	118.5	0	1 371.6
FLUAZIFOP-P-BUTYL	Herbicide	1 830.8	0.01	5 808.5	0.06	12 914.0
TERBUFOS	Insecticide	1 797.0	0.01	2 893.0	0.03	6 697.8
TERBACIL	Herbicide	1 728.0	0.01	332.8	0	891.2
PARAQUAT	Herbicide	1 727.6	0.01	1 591.6	0.02	4 820.4
SILOXYLATED POLYETHER	Adjuvant	1 690.2	0.01	1 130.9	0.01	
PIPERONYL BUTOXIDE	Insecticide	1 607.3	0.01	405.1	0	591.6
SULPHUR (FUNGICIDE)	Fungicide	1 523.2	0.01	2 968.1	0.03	7 315.4
MANEB	Fungicide	1 521.5	0.01	3 346.4	0.04	8 462.0
DIMETHOATE	Insecticide	1 456.5	0.01	1 691.1	0.02	4 883.4
PERMETHRIN	Insecticide	1 402.7	0.01	315.8	0	397.2
SOAP	Insecticide	1 331.8	0.01	947.2	0.01	
SULPHUR (INSECTICIDE)	Insecticide	1 314.0	0.01	96.6	0	280.7
PYROXSULAM	Herbicide	1 251.4	0.01			
DEET	Insecticide	1 201.9	0.01	3 413.3	0.04	4 167.9
METALAXYL	Fungicide	1 164.1	0.009	302.2	0	3 796.2
FLUDIOXONIL	Fungicide	1 100.6	0.009	24 377.7	0.26	
Z-9-TRICOSENE	Insecticide	1 097.3	0.009	0.16	0	0.6
THIOPHANATE-METHYL	Fungicide	1 024.9	0.008	454.7	0	859.4
PENDIMETHALIN	Herbicide	1 003.2	0.008	782.8	0.01	1 061.1
SAFER'S INSECTICIDAL SOAP	Insecticide	902.0	0.007	1 040.2	0.01	1 641.6

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
MALEIC HYDRAZIDE	Growth Regulator	867.8	0.007	1 952.7	0.02	551.7
PROMETRYNE	Herbicide	855.5	0.007	586.3	0.01	
S-METOLACHLOR	Herbicide	830.9	0.007	3 278.9	0.04	
NALED	Insecticide	823.0	0.007	972.6	0.01	1 257.9
CORN GLUTEN MEAL	Herbicide	705.6	0.006			
POTASSIUM SALTS OF FATTY ACIDS	Insecticide	687.3	0.006			
CLOTHIANIDIN	Insecticide	686.8	0.006			
IMIDACLOPRID	Insecticide	647.1	0.005	978	0.01	9.5
DESMEDIPHAM	Herbicide	645.2	0.005	1 348.5	0.01	2 334.8
METIRAM	Fungicide	619.2	0.005	2 068.8	0.02	14 862.4
ASPHALT SOLIDS	Fungicide	614.7	0.005	591.9	0.01	1 387.5
STRYCHNINE	Rodenticide	595.5	0.005	244.8	0	163.2
DICHLOBENIL	Herbicide	572.3	0.005	684.7	0.01	728.2
ALUMINUM PHOSPHIDE	Insecticide	569.3	0.005	269.6	0	2 215.7
LIME SULPHUR	Fungicide	564.6	0.005	364.8	0	224
PROPAMOCARB HYDROCHLORIDE	Fungicide	540.1	0.004	411.9	0	1 271.3
DELTAMETHRIN	Insecticide	537.6	0.004	2 735.1	0.03	775.1
SURFACTANT MIXTURE	Adjuvant	533.8	0.004			
PARADICHLOROBENZENE	Insecticide	508.5	0.004	13.9	0	65.3
PROPYZAMIDE	Herbicide	475.7	0.004	179.4	0	272
FOSETYL-AL	Fungicide	466.5	0.004	351.8	0	166.3
FORMALDEHYDE	Fungicide	464.0	0.004	17.8	0	96.2
PHENMEDIPHAM	Herbicide	434.1	0.003	1 348.5	0.01	2 330.3
CAPTAN	Insecticide	429.8	0.003	439.4	0	286.8
ACETAMIPRID	Insecticide	414.6	0.003			
THIABENDAZOLE	Fungicide	412.5	0.003	1 388.8	0.01	3 187.2
COPPER NAPHTHENATE	Anti-microbial	404.6	0.003	59.8	0	123.2
MCPB	Herbicide	396.0	0.003	1 717.5	0.02	3 271.5
DAZOMET	Soil fumigant	392.0	0.003	78.4	0	627.2
ACEPHATE	Insecticide	376.9	0.003	383.6	0	257.6
TRIBASIC COPPER SULPHATE	Fungicide	375.9	0.003	130.9	0	159.6
CYFLUTHRIN	Insecticide	351.6	0.003	92.3	0	1.3
PYRIDABEN	Insecticide	350.6	0.003	23.5	0	17.1
DRIED BLOOD	Vertebrate	327.0	0.003			
ENDOSULFAN	Insecticide	294.9	0.002	5 229.7	0.05	761.1
BORAX	Insecticide	291.8	0.002	168.2	0	218.8
SODIUM ALPHA-OLEFIN SULFONATE	Adjuvant	291.0	0.002	299.1	0	

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
METSULFURON-METHYL	Herbicide	286.3	0.002	360.9	0	938.6
BRONOPOL	Preservative	276.4	0.002	192.1	0	
CARBOFURAN	Insecticide	265.0	0.002	676.1	0.01	6 413.4
DICHLORVOS	Insecticide	254.6	0.002	193.5	0	335.2
PYRETHRINS	Insecticide	240.0	0.002	220.9	0	178.2
ETHAMETSULFURON-METHYL	Herbicide	238.0	0.002	844.4	0.01	4 636.4
METHAMIDOPHOS	Insecticide	230.4	0.002	1 008.0	0.01	19.2
CHLORSULFURON	Herbicide	225.8	0.002	98.6	0	66.7
OXYCARBOXIN	Fungicide	216.5	0.002	185.3	0	154.1
QUINCLORAC	Herbicide	213.2	0.002	878.1	0.01	1 459.4
NAPROPAMIDE	Herbicide	211.9	0.002	159.1	0	294.6
RIMSULFURON	Herbicide	208.4	0.002	219.1	0	63.2
SOAP (HERBICIDAL)	Herbicide	188.4	0.002	42.4	0	1221.5
BACILLUS THURINGIENSIS SSP KURSTAKI	Insecticide	184.5	0.001	35.8	0	28 273.5*
METHOPRENE	Insecticide	174.1	0.001	6.7	0	
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide	154.8	0.001	33.4	0	144.5
ZINC NAPHTHENATE	Anti-microbial	153.5	0.001	23.6	0	40
BACILLUS SPHAERICUS	Insecticide	152.4	0.001			
N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Disinfectant	148.0	0.001	163.4	0	63.7
DI-N-PROPYL ISOCINCHOMERONATE	Insecticide	144.9	0.001	5.8	0	6.4
COPPER OXYCHLORIDE	Fungicide	144.7	0.001	649.5	0.01	220.2
BORACIC ACID	Insecticide	135.8	0.001	41.6	0	322.7
RESMETHRIN	Insecticide	134.0	0.001	17.5	0	2.4
NICOSULFURON	Herbicide	126.7	0.001	140.1	0	
DIDECYL DIMETHYL AMMONIUM CHLORIDE	Anti-microbial	106.5	0.001	167.4	0	120.6
METALDEHYDE	Insecticide	105.5	0.001	101.3	0	476.5
OXYFLUORFEN	Herbicide	89.0	0.001	46	0	27.4
FERBAM	Herbicide	80.1	0.001	95.1	0	77.6
TRINEXAPAC-ETHYL	Growth Regulator	77.7	0.001	44.8	0	
TRIFLUSULFURON METHYL	Herbicide	75.1	0.001	81.8	0	
PYRAZON	Herbicide	72.2	0.001	338	0	1 204.9
AZINPHOS-METHYL	Insecticide	69.2	0.001	304	0	260.6
BACILLUS THURINGIENSIS SSP ISRAELENSIS	Insecticide	62.2	0	34.4	0	11 079.8*
DAMINOZIDE	Growth Regulator	57.8	0	119.9	0	147.5

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
PYMETROZINE	Insecticide	55.5	0	95	0	
ETRIDIAZOLE	Herbicide	54.9	0	122.1	0	210.6
METHOMYL	Insecticide	54.8	0	436.8	0	434.5
CHLORMEQUAT	Growth Regulator	54.3	0	89.7	0	62.3
ZINEB	Fungicide	51.5	0	99.5	0	491.7
ROTENONE	Herbicide	49.7	0	61.7	0	180
TRIASULFURON	Herbicide	45.5	0	190.3	0	505
PROPOXUR	Insecticide	41.3	0	107.2	0	170
FATTY ACID	Growth Regulator	36.9	0	88.9	0	34.6
NICOTINE	Insecticide	36.4	0	27.2	0	27.5
FOLPET	Insecticide	35.9	0	55.4	0	54.8
WATER SOLUBLE DYES	Herbicide	35.1	0	48.7	0	5.1
NATURAL GUM RESINS	Insecticide	32.3	0	0.67	0	9
PROPANIL	Herbicide	32.0	0	96	0	1616
CYPERMETHRIN	Insecticide	30.9	0	26.1	0	439.6
SILICON DIOXIDE FRESH WATER FOSSILS	Insecticide	29.0	0			
FERRIC PHOSPHATE	Insecticide	28.8	0	11.3	0	
FERIC SODIUM EDTA	Insecticide	28.1	0			
OIL OF BLACK PEPPER	Vertebrate	27.7	0	16.5	0	12
OXADIAZON	Herbicide	27.2	0	19.9	0	41.2
DICOFOL	Insecticide	27.0	0	84	0	423.6
ZINC PHOSPHIDE	Rodenticide	26.3	0	435.3	0	49.2
D-TRANS ALLETHRIN	Insecticide	25.2	0	320.6	0	20.7
METHYL NONYL KETONE	Vertebrate	24.1	0	27.5	0	50
COPPER SULPHATE	Fungicide	23.7	0	672.1	0.01	316.1
CHLORPHACINONE	Rodenticide	23.7	0	1.7	0	1.8
PHOSALONE	Insecticide	21.4	0	23.5	0	5.6
POTASSIUM MONOPERSULPHATE	Disinfectant	20.3	0	59.9	0	15
CHLORPROPHAM	Herbicide	20.2	0	120.4	0	679.8
PROPETAMPHOS	Insecticide	18.9	0	0.29	0	
SPINOSAD FACTOR A PLUS	Insecticide	18.7	0	1.9	0	
TETRAMETHRIN	Insecticide	18.4	0	20.3	0	14.2
BACILLUS SUBTILUS	Insecticide	17.7	0			
OXINE BENZOATE	Fungicide	17.0	0	52.5	0	59.1
MYCLOBUTANIL	Fungicide	16.7	0	162.6	0	16.8
TEBUFENOZIDE	Insecticide	15.4	0	8.6	0	
D-CIS, TRANS ALLETHRIN	Insecticide	15.1	0	5.7	0	1.7
D-PHENOTHRIN	Insecticide	14.8	0	6.8	0	

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
FENHEXAMID	Fungicide	14.3	0	2.5	0	
BIFENAZATE	Insecticide	12.6	0			
PUTRESCENT WHOLE EGG SOLIDS	Vertebrate	11.3	0			
SPIROTETRAMAT	Insecticide	10.3	0			
MESOTRIONE	Fungicide	9.2	0			
FENBUTATIN OXIDE	Insecticide	8.6	0	22.1	0	12.4
BROMADIOLONE	Rodenticide	5.9	0	1.2	0	1.2
DICLOFOP-METHYL	Herbicide	5.7	0	715.2	0.01	3 239.9
PHOSMET	Insecticide	5.6	0	140.7	0	370
SULFOSULFURON	Herbicide	5.2	0	596.3	0.01	
FENAMIDONE	Fungicide	5.0	0			
WARFARIN	Rodenticide	3.8	0	2	0	1.8
GLIOCLADIUM CATENULATUM	Fungicide	3.6	0			
DODEMORPH-ACETATE	Fungicide	3.6	0	42.8	0	55.2
ACEQUINOCYL	Insecticide	3.5	0			
PACLOBUTRAZOL	Growth Regulator	3.0	0	0.23	0	
ABAMECTIN	Insecticide	2.9	0	6.7	0	3.6
CYROMAZINE	Insecticide	2.7	0	9.8	0	
KINOPRENE	Insecticide	2.5	0	9.9	0	33.6
OXAMYL	Insecticide	2.4	0	2.4	0	9.6
BRODIFACOUM	Rodenticide	2.3	0	0.08	0	0.1
AMMONIA	Rodenticide	2.3	0	0.43	0	1.1
DIFLUBENZURON	Insecticide	2.3	0	2.6	0	
DIMETHOMORPH	Fungicide	1.8	0	9.9	0	72.9
SPIROMESIFEN	Insecticide	1.7	0			
1-OCTEN-3-OL	Insecticide	1.6	0			
ISOXABEN	Herbicide	1.4	0			
P-MENTHANE-3, 8-DIOL	Insecticide	1.3	0	22.7	0	
PIPERINE	Rodenticide	1.0	0	0.62	0	0.4
PYRIPROXYFEN	Insecticide	0.9	0			
CYPRODINIL	Fungicide	0.9	0			
DIPHACINONE	Rodenticide	0.9	0	0.37	0	0.4
HYDRAMETHYLNON	Insecticide	0.9	0	20.4	0	9.2
FENTHION	Insecticide	0.8	0	418.8	0	293.6
QUIZALOFOP-ETHYL	Herbicide	0.8	0	44.7	0	23 101.0
BISPYRIBAC	Herbicide	0.5	0			
DENATONIUM BENZOATE	Vertebrate	0.5	0			
4-AMINOPYRIDINE	Rodenticide	0.4	0	0.21	0	1.5
ARTIFICIAL ESSENTIAL OIL BLEND	Insecticide	0.4	0			

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
SULFAQUINOXALINE	Rodenticide	0.4	0	0.41	0	1.4
DIFETHIALONE	Rodenticide	0.2	0	0.06	0	
SPINETORAM	Insecticide	0.2	0			
BROMETHALIN	Rodenticide	0.2	0			
BENDIOCARB	Insecticide	0.2	0	36	0	59.3
CAPSAICIN	Vertebrate	0.2	0	0.1	0	0.1
ANCYMIDOL	Growth Regulator	0.03	0	0.03	0	0.1
4-CPA	Growth Regulator	0.03	0			
D-CIS ALLETHRIN	Insecticide	0.03	0			
UNICONAZOLE-P	Growth Regulator	0.02	0			
STREPTOMYCES LYDICUS	Fungicide	0.02	0			
STREPTOMYCES GRISEOVIRIDIS	Fungicide	0.008	0	0.04	0	
GERMAN COCKROACH EXTRACT	Insecticide	0.006	0			
GIBBERELLIC ACID	Growth Regulator	0.004	0	0.06	0	0.6
CHOLECALCIFEROL	Rodenticide	0.003	0	0.012	0	0.1
AMMONIUM SULPHATE	Herbicide			51 595.1	0.56	71 104.4
LINDANE	Insecticide			4 779.5	0.05	56 743.7
BENOMYL	Fungicide			3 275.0	0.04	14 616.3
TRICHLORFON	Insecticide			2 331.3	0.03	34 334.3
HYDROGEN PEROXIDE	Insecticide			996.8	0.01	
MUSTARD SEED POWDER (BRASSICA HIRTA)	Rodenticide			471.3	0.01	
CYCLOATE	Herbicide			460.8	0	2 289.6
METAM	Soil fumigant			415.1	0	410.7
CHLORONEB	Fungicide			233.9	0	559.3
PROPYZAMIDE	Herbicide			179.4	0	272
TALL OIL FATTY ACIDS	Adjuvant			176	0	1 470.4
PIRIMICARB	Insecticide			162.2	0	154.1
TALLOW FATTY ACID AMINE ETHOXYLATE	Adjuvant			138.1	0	3 272.2
TRIADIMENOL	Fungicide			120.1	0	178
SODIUM METABORATE TETRAHYDRATE	Herbicide			117.5	0	1 616.3
BENSULIDE	Herbicide			95.9	0	212.6
PARAFORMALDEHYDE	Disinfectant			68.3	0	
CYMOXANIL	Fungicide			65.9	0	
OCTYLPHENOXYPOLYETHOXY ETHANOL PHOSPHATE ESTER	Adjuvant			60.5	0	

ACTIVE INGREDIENT NAME	Type of use	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)
CREOSOTE	Anti-microbial			58.1	0	805.2
SODIUM CHLORATE	Herbicide			53	0	729.1
CYANAZINE	Herbicide			45	0	3 891.6
ENDOTHALL	Herbicide			44.3	0	511
N-ALKYL POLYETHOXYETHANOL	Adjuvant			32.5	0	52.5
METHOXYCHLOR	Insecticide			24.7	0	109.9
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	Anti-microbial			22.4	0	20.5
TRIFORINE	Fungicide			22	0	20.6
POLYMERIZED BUTENES	Vertebrate			21.7	0	92.9
N-ALKYL DIETHANOLAMINE	Adjuvant			20.8	0	33.6
1,2-ETHANEDIOL	Adjuvant			17.4	0	87
PYRIDATE	Herbicide			12.6	0	486
METHIOCARB	Insecticide			12.1	0	
METOLACHLOR	Herbicide			11.2	0	4 297.9
COUMAPHOS	Insecticide			7.3	0	45.6
10,10'-OXYBIS(PHENOXARSINE)	Preservative			5.3	0	
ETHION	Insecticide			4.6	0	26.9
METHYL ANTHRANILATE	Vertebrate			4.1	0	
FENVALERATE	Fungicide			3.8	0	4.1
ALLETHRIN	Insecticide			2.8	0	2
FENHEXAMID	Fungicide			2.5	0	
STREPTOMYCIN	Fungicide			1	0	2.1
FLAMPROP-M-METHYL	Herbicide			0.08	0	1 091.5
DITHIOPYR	Herbicide			0.05	0	2.1
6-BENZYLAMINOPURINE	Growth Regulator			0.04	0	
FENOXAPROP-ETHYL	Herbicide			0.012	0	117.9
ERGOCALCIFEROL	Rodenticide			0.002	0	0.02
TOTAL		**12 476 095.8**	**100**	**9 264 487.7**	**100**	**9 300 497.8**

Note: *Bacillus thuringiensis* active ingredient calculations in 1998 assumed that formulation consisted of 100% active ingredient, as guarantees on a percentage basis were not available. Guarantees on a percentage basis were obtained for these products in 2003. Recalculating the 1998 figures resulted in total active ingredient sold for *Bt kurstaki* and *Bt israelensis* of 617.994 and 1.654 kg ai, respectively.

Appendix 4. 2008 Pesticide Sales by Active Ingredient (kg) and River Basin

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
1-OCTEN-3-OL		0.4	0.1	0.002	0.1			0.3	0.1	0.2	0.4	0.01	0.04	1.6
2,4-D	37 798.0	15 063.8	67 044.2	7 309.7	96 871.5		16 323.1	73 676.8	294 865.8	44 304.3	151 946.4	18 547.3	149 331.3	973 082.3
2,4-DB		166.5	166.3		93.8			523.8	443.3	512.0	1 697.0		37.5	3 640.0
4-AMINOPYRIDINE	0.4													0.4
4-CPA	0.001	0.0002	0.01		0.01			0.004		0.0005	0.01			0.03
ABAMECTIN	2.7	0.002	0.002	0.0003	0.2			0.01	0.003	0.002	0.01	0.0001	0.001	2.9
ACEPHATE	163.1				23.6				13.5		14.6		162.0	376.9
ACEQUINOCYL	3.5													3.5
ACETAMIPRID	6.1		32.3		0.5				375.5				0.2	414.6
ACETIC ACID	2 215.0	54.4	42.9	10.9	629.1			6 936.3	1 384.0	482.1	113.8	0.6	46.5	11 915.6
ACROLEIN									9 051.0					9 051.0
ALUMINUM PHOSPHIDE	141.2				17.3				214.4		152.2		44.3	569.3
AMINOPYRALID	1 357.4	407.3	540.3	33.9	131.3			852.0	237.1	196.8	505.3		97.0	4 358.4
AMITROLE	3 940.2	0.7	8.3		20.7			132.2	208.7	586.3	40.9	55.4	1.0	4 994.5
AMMONIA			0.5		1.7				0.01	0.1				2.3
ANCYMIDOL	0.03				0.002									0.03
ARTIFICIAL ESSENTIAL OIL BLEND		0.04								0.3	0.04	0.01		0.4
ASPHALT SOLIDS		10.0	366.3	2.3	56.2			84.8	17.4	53.2	17.2	0.9	6.5	614.7
ATRAZINE		332.2	1 422.8		84.4			221.6	3 616.4		476.5	18.9		6 172.7
AZINPHOS-METHYL								68.1			1.1			69.2
AZOXYSTROBIN	51.4	9.5	739.2	1.9	192.8			1 044.7	2 442.4	1.9	186.5		229.5	4 899.6
BACILLUS SPHAERICUS	152.4													152.4
BACILLUS SUBTILIS	17.7													17.7
BACILLUS THURINGIENSIS BERLINER SSP KURSTAKI	59.0	0.4	121.1	0.002	0.5			0.9	0.1	0.1	2.1		0.3	184.5
BACILLUS THURINGIENSIS.	55.7	0.02	0.1	0.01	3.0			0.1	2.6	0.04	0.2		0.4	62.2

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
SEROTYPE H-14														
BENDIOCARB	0.2													0.2
BENTAZON		107.0	1 857.6		64.8			1 048.3	8 238.1	2 403.4	2 214.7	28.3	4 518.7	20 481.0
BIFENAZATE	12.6													12.6
BISPYRIBAC	0.5													0.5
BORACIC ACID	120.5	1.4	3.8	0.3	0.9			2.7	1.3	1.8	2.3		0.9	135.8
BORAX	3.8	12.1	38.1	2.4	81.3	0.1	0.2	83.1	18.5	10.5	31.3	0.2	10.3	291.8
BOSCALID		1 721.5	3 498.4	1 024.2	1 047.9			1 136.6	5 704.1	1 228.2	2 111.0		3 047.9	20 519.8
BRODIFACOUM	0.028	0.1	0.2	0.02	0.4			0.6	0.3	0.2	0.4	0.03	0.1	2.3
BROMACIL		898.1	72.9	5.1	53.4		0.3	85.3	372.8	44.0	565.2	18.2	371.6	2 486.9
BROMADIOLONE	0.6	0.3	0.6	0.1	1.1			1.3	0.6	0.3	0.9	0.1	0.1	5.9
BROMETHALIN	0.00004	0.01	0.1		0.01			0.04	0.1	0.01	0.03		0.004	0.2
BROMOXYNIL		4 786.1	27 246.3	2 107.1	33 968.5		6 438.1	21 787.6	97 933.6	7 173.9	66 289.2	11 951.6	50 495.3	330 177.1
BRONOPOL			0.003		103.8			107.7	19.5	15.1	22.3		8.0	276.4
BUTOXYPOLYPROPYLENE GLYCOL	424.1	408.3	234.4	101.8	646.0			761.0	292.8	642.4	526.8	30.0	93.9	4 161.6
CAPSAICIN	0.003	0.01	0.01	0.003	0.1			0.05	0.01	0.01	0.02		0.01	0.2
CAPTAN	45.8	1.4	4.3	0.6	28.5			15.7	15.3	0.9	314.7		2.7	429.8
CARBARYL	1 032.2	560.6	1 060.9	79.8	1 350.4			2 344.0	938.7	1 251.7	855.9	25.9	287.3	9 787.3
CARBATHIIN	247.0	173.6	1 667.7	75.8	1 818.5		372.6	1 672.6	3 928.7	1 044.1	2 647.9	152.0	1 430.7	15 231.1
CARBOFURAN			3.8		3.8				32.6	11.5	7.7		205.4	265.0
CARFENTRAZONE-ETHYL		76.2	1 299.8	22.2	69.5			664.1	83.2	230.7	207.1	16.7	25.1	2 694.4
CHLORMEQUAT	47.8				6.5									54.3
CHLOROPHACINONE	22.0	0.03	0.3	0.1	0.3			0.5	0.01	0.005	0.4	0.0003	0.02	23.7
CHLOROTHALONIL	1 554.7	97.0	1 078.4	60.6	2 078.5			995.0	28 446.4	32.3	294.9	4.0	1 052.0	35 693.8
CHLORPROPHAM					3.4				16.8					20.2
CHLORPYRIFOS	3.4	541.0	30 865.3	182.4	16 717.8			6 198.0	2 729.0	110.4	14 289.8	4 798.0	6 293.7	82 728.7
CHLORSULFURON	108.8	75.0	22.6					0.8		18.8				225.8

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
CHOLECALCIFEROL	0.003													0.003
CLETHODIM		1 316.2	3 400.7	107.3	1 854.7			4 115.1	2 154.9	2 969.3	3 455.2	193.0	389.5	19 955.8
CLODINAFOP-PROPARGYL		628.9	6 230.3	67.4	2 970.4		997.9	5 065.4	10 729.2	4 406.9	7 258.2	1 175.3	7 352.5	46 882.3
CLOPYRALID	64.1	2 141.0	10 258.6	202.8	5 152.1		131.2	10 174.4	7 194.4	12 804.3	8 797.7	787.1	631.4	58 339.1
CLOTHIANIDIN		4.8	155.5	5.9			0.2	81.1	308.9	56.9	59.8		13.8	686.8
COPPER (CUPRIC) HYDROXIDE	6.1				48.4				1 949.6		134.2		1 054.2	3 192.6
COPPER NAPHTHENATE		70.4	33.5	6.3	21.2		0.6	129.0	13.2	44.8	82.1	0.5	2.9	404.6
COPPER OXYCHLORIDE	120.5	0.6	0.3	0.1	2.2			7.7	10.7	0.5	1.6		0.4	144.7
COPPER SULPHATE	8.4	5.2	0.4		0.1			1.7	1.1	3.4	3.0	0.6		23.7
COPPER SULPHATE TRIBASIC	14.0	2.2	41.5		46.5			51.3	1.9	7.3	208.7		2.5	375.9
CORN GLUTEN MEAL			88.2	35.3	88.2			158.8	229.3	35.3	70.6			705.6
CYFLUTHRIN	26.0	17.6	46.7	0.4	21.1			19.3	139.6	6.3	47.1	10.2	17.3	351.6
CYHALOTHRIN-LAMBDA	13.9	11.4	43.6	5.4	296.7		11.2	14.1	1 244.0	848.6	315.0	4.2	139.6	2 947.5
CYPERMETHRIN					0.8			1.6	6.0	21.2	1.1		0.3	30.9
CYPRODINIL	0.9													0.9
CYROMAZINE	1.0				1.7									2.7
DAMINOZIDE	45.5				12.3									57.8
DAZOMET	392.0													392.0
D-CIS ALLETHRIN		0.004			0.0			0.004						0.03
D-CIS, TRANS ALLETHRIN	0.13	2.8	1.3	0.1	1.9			1.9	1.4	2.6	2.6	0.2	0.2	15.1
DEET	387.5	84.0	50.5	11.5	250.2			104.0	33.5	137.7	126.7	3.8	12.6	1 201.9
DELTAMETHRIN	2.2	3.0	30.9	1.8	52.0			16.5	265.3	25.1	75.9	1.0	63.9	537.6
DENATONIUM BENZOATE	0.2	0.03	0.01		0.05			0.1	0.05	0.01	0.02			0.5
DESMEDIPHAM					15.0			0.8	545.2		1.5		82.7	645.2
DIAZINON	109.3	10.0	52.2	25.0	432.5			151.9	1 594.0		62.5	0.8	103.3	2 541.5
DICAMBA	8 914.0	1 613.7	3 107.6	140.6	3 526.3		1 182.0	6 399.8	22 441.9	3 411.5	19 992.9	1 284.5	22 663.0	94 677.9

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
DICHLOBENIL	84.0	14.2	19.8	0.2	53.7			37.8	220.3	41.6	82.6	3.0	15.1	572.3
DICHLORPROP	2 268.0	27.0	2 773.5		1 676.8		1 871.3	813.4	1 7405.0	33.2	2 598.6	354.0	22 450.9	52 271.6
DICHLORVOS	140.6	8.9	11.5	1.9	25.5			34.0	8.1	5.0	16.1	0.2	3.0	254.6
DICLOFOP-METHYL											5.7			5.7
DICOFOL	10.5								4.5		12.0			27.0
DIDECYL DIMETHYL AMMONIUM CHLORIDE	106.5													106.5
DIFENOCONAZOLE	1.9	374.7	1 665.4	18.0	2 064.1		31.4	1 826.0	2 599.3	753.7	2 566.6	138.7	1 559.5	13 599.3
DIFENZOQUAT		128.0	248.0		192.0			70.0	1 410.0	364.0	918.0		462.0	3 792.0
DIFETHIALONE	0.1	0.0002	0.01	0.0003	0.1			0.05	0.001	0.002	0.003	0.0001	0.002	0.2
DIFLUBENZURON	1.5				0.8									2.3
DIMETHOATE	67.2	9.6	4.8		252.5			52.8	637.6	14.4	248.8		168.8	1 456.5
DIMETHOMORPH											1.8			1.8
DI-N-PROPYL ISOCINCHOMERONATE		16.7	8.4	3.6	26.7			31.2	10.8	23.5	16.9	0.5	6.6	144.9
DIPHACINONE	0.05	0.02	0.2	0.004	0.3			0.2	0.04	0.03	0.1	0.01	0.01	0.9
DIQUAT	15.1	655.3	5 536.6	19.2	1 721.1		69.6	3 628.3	10 028.6	3 202.1	5 909.9	271.2	3 837.1	34 893.9
DIURON	24 583.0	840.0	24.0					9 583.0	300.3	440.0	528.0		1 376.0	37 674.4
DODEMORPH-ACETATE	2.0				1.6									3.6
D-PHENOTHRIN		0.6	0.3	0.1	6.9			3.4	1.0	0.4	1.6	0.01	0.3	14.8
DRIED BLOOD	24.5		10.4		143.2			39.7	18.0	42.5	45.4		3.3	327.0
D-TRANS ALLETHRIN	2.2	0.8	3.1	0.2	8.0		0.01	6.3	1.1	0.8	2.2	0.03	0.5	25.2
ENDOSULFAN	37.0	0.2			16.9			200.3	40.0	0.3	0.2			294.9
EPTC			24.0					32.0	10 416.0		352.0		200.0	11 024.0
ETHALFLURALIN		1 347.9	2 029.3		1 685.8		514.0	1 586.6	49 459.7	799.7	8 001.4	31.3	17 418.2	82 873.7
ETHAMETSULFURON-METHYL		0.5	10.6		1.3		1.0	11.3	121.2	49.2	14.2	9.4	19.4	238.0
ETHEPHON	62.4				177.6				420.0		516.0		1 212.0	2 388.0
ETHOFUMESATE									5 625.6				892.8	6 518.4

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
ETRIDIAZOLE	47.2		0.002		7.7			0.002		0.0001	0.0001			54.9
FATTY ACID	13.7	0.9	0.9	0.2	8.6			8.6	0.9	0.8	1.8		0.6	36.9
FENAMIDONE									5.0					5.0
FENBUTATIN OXIDE	6.8				1.9									8.6
FENHEXAMID	5.3									9.0				14.3
FENOXAPROP-P-ETHYL		2 748.9	8 147.2	316.9	7 042.9		586.2	4 838.2	9 570.0	7 008.5	9 486.0	2 294.3	6 360.5	58 399.7
FENTHION			0.8											0.8
FERBAM		3.7	4.7	1.1	16.1			33.4	4.7	2.4	8.6		5.5	80.1
FERRIC PHOSPHATE	0.2	0.8	0.9	0.1	9.7			11.3	1.1	1.2	2.8	0.1	0.7	28.8
FERRIC SODIUM EDTA					17.3			10.8						28.1
FERROUS SULFATE	5 143.9	157.7	1 582.1	3.0	169.8			104.5	644.3	27.3	12.0		2.1	7 846.5
FLORASULAM		252.3	2 585.0	59.6	2 174.9		21.4	1 655.5	3 601.9	1 166.1	3 044.7	229.0	970.1	15 760.4
FLUAZIFOP-P-BUTYL		0.8	140.5		48.2			221.7	57.9	1 057.0	192.8	4.9	107.0	1 830.8
FLUCARBAZONE SODIUM		256.0	2 102.2		597.7		7.1	1 264.8	1 434.7	455.7	1 707.0	84.6	423.1	8 333.0
FLUDIOXONIL	5.4	5.0	171.1	0.8	25.1		0.2	83.6	726.1	7.9	39.8	0.2	35.3	1 100.6
FLUROXYPYR		995.6	11 976.4	102.0	6 651.8		532.8	6 733.0	21 641.7	8 098.3	12 663.7	129.6	2 289.3	71 814.1
FOLPET	3.2	0.3	14.4		6.3			9.3	0.1	0.4	1.7		0.1	35.9
FORMALDEHYDE	455.1		8.9											464.0
FOSETYL-AL	379.7				86.8									466.5
GERMAN COCKROACH EXTRACT		0.0002	0.00007	0.00002	0.002			0.003	0.0001	0.0001	0.0004		0.00003	0.006
GIBBERELLIC ACID	0.004													0.004
GLIOCLADIUM CATENULATUM	3.6													3.6
GLUFOSINATE AMMONIUM	98.9	23 219.9	76 285.5	2 207.4	26 401.2		218.7	96 412.3	18 972.2	82 141.3	61 607.9	3 654.2	4 461.4	395 681.1
GLYPHOSATE	71 932.5	230 103.5	968 537.2	48 462.8	472 541.7		39 452.8	881 806.0	1 026 868.4	817 839.9	1 047 146.3	133 480.5	497 326.9	6 235 498.5
HEXAZINONE		12.0			276.0			237.0	1 438.7	36.0	1 540.5			3 540.2
HYDRAMETHYLNON	0.9													0.9

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
IMAZAMETHABENZ		6 036.1	13 683.3	3 858.8	9 065.5		45.4	19 909.8	10 808.6	16 128.7	11 953.7	1 296.0	1 218.2	94 004.3
IMAZAMOX		148.3	1 420.8	48.6	503.2		7.0	878.9	1 896.0	1 004.9	978.2	178.4	709.5	7 773.9
IMAZETHAPYR		99.7	1 365.6	21.6	391.0		7.0	834.6	1 482.4	335.2	836.5	148.4	673.5	6 195.7
IMAZAPYR	1 960.8	766.1	31.9		68.4			86.6	29.6	857.3	27.4			3 828.1
IMIDACLOPRID	66.2	0.9	239.4		29.8		10.0	7.3	264.5	0.5	20.4	0.2	7.9	647.1
IPRODIONE	1 767.3	4 423.5	9 868.5	258.3	6 072.4			7 742.4	2 829.8	11 261.0	12 283.8	2.1	864.9	57 374.1
ISOXABEN	1.4													1.4
KINOPRENE	1.9				0.7									2.5
LIME SULPHUR	184.9	4.6	161.7		49.7			139.1		8.3	13.1		3.2	564.6
LINURON	4.8	2 387.2	1 440.9	4.8	417.8			384.2	1 852.4	72.0	339.6	356.2	57.6	7 317.5
MALATHION	419.8	719.3	1 917.6	118.3	862.0		54.0	1 764.2	4 382.5	934.1	1 605.2	128.7	571.5	13 477.1
MALEIC HYDRAZIDE									867.8					867.8
MANCOZEB	109.4		156.8		1 600.5			1 368.7	18 723.2	24.7	153.4	1.1	217.6	22 355.4
MANEB		166.0	143.1		349.8		40.1	71.1	329.3	110.5	311.7			1 521.5
MCPA	485.0	49 494.3	199 269.3	8 930.9	81 593.7		2 713.7	189 418.7	110 315.2	158 837.8	184 395.1	22 010.2	21 531.8	1 028 995.8
MCPB		120.0	30.0					22.5	174.8	48.8				396.0
MECOPROP (D-ISOMER)	716.1	119.6	74.1	18.8	836.9		2.3	504.2	267.3	70.6	470.4	2.5	188.1	3 271.0
MECOPROP-P	2 171.0	1 921.0	3 043.6	375.0	6 869.3		155.8	10 431.8	8 378.0	2 574.7	3 754.7	299.5	3 345.5	43 319.9
MESOTRIONE								9.2						9.2
METALAXYL	0.6	69.3	304.2	5.8	277.8		16.0	130.5	159.8	47.2	122.4	0.7	29.9	1 164.1
METALAXYL-M	31.0	31.6	371.5	0.8	211.9		2.9	323.9	2 781.8	60.4	270.5	11.5	259.2	4 357.1
METALDEHYDE	0.9	2.8	12.7	0.7	25.4			48.3	2.8	3.2	7.5	0.04	1.0	105.5
METHAMIDOPHOS	4.8			4.8				67.2	105.6		48.0			230.4
METHOMYL		1.7	4.0		1.0			8.5	3.6	1.0	6.9		28.2	54.8
METHOPRENE	174.1									0.05				174.1
METHYL BROMIDE	6 106.3													6 106.3
METHYL NONYL KETONE	1.9	1.3	4.4	0.2	4.6			5.8	0.9	1.4	2.8	0.02	0.8	24.1
METHYLATED CANOLA OIL		8 903.0	33 633.8	11.0	14 810.3			36 187.2	2 070.7	23 483.1	67 462.1	700.3	124.1	187 385.6

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
METIRAM									614.4		1.6	3.2		619.2
METRIBUZIN		99.4	317.1	11.3	46.9			375.0	3 786.6	90.8	135.5		198.8	5 061.1
METSULFURON-METHYL	12.5	20.9	45.6	0.5	4.2			32.8	6.3	145.5	15.4	2.1	0.4	286.3
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	2 418.1	11.6	372.5		377.7			665.9		17.5	27.6		6.8	3 897.7
MYCLOBUTANIL	8.2				2.0								6.5	16.7
NALED	13.1								689.1		16.3		104.5	823.0
N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE								12.0	136.0					148.0
NAPHTHALENE		252.3	258.6	58.2	424.1	2.4	7.5	559.9	150.1	225.3	323.9	3.2	52.7	2 318.2
NAPROPAMIDE	84.2				20.8			22.7	82.4		1.8			211.9
NATURAL GUM RESINS	2.3		3.2		13.3			8.5			3.7		1.3	32.3
NICOSULFURON		15.1	35.3		0.6			15.3	19.3		22.7		18.4	126.7
NICOTINE	21.4				15.0									36.4
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	18.1	8.1	13.7	0.7	48.0		0.01	41.1	5.7	5.8	10.7	0.1	2.8	154.8
NONYLPHENOXYPOLYETHOXYETHANOL	135.0	7 267.2	7 061.7	1 159.2	3 585.9			11 966.7	8 444.2	5 318.8	9 348.2	484.4	3 862.9	58 634.2
OCTYLPHENOXYPOLYETHOXYETHANOL	9.5	413.9	917.4		28.4			515.4	706.0	137.0	1 166.6	26.5		3 920.6
OIL OF BLACK PEPPER	0.5	1.6	1.7	0.5	9.1			7.7	1.9	1.3	2.4		1.0	27.7
OXADIAZON	21.8				3.6						1.8			27.2
OXAMYL	2.4													2.4
OXINE BENZOATE	5.6	0.3	1.3		5.1			2.8	0.04	0.2	1.6		0.02	17.0
OXYCARBOXIN	61.8				154.8									216.5
OXYFLUORFEN	21.6								28.8				38.6	89.0
PACLOBUTRAZOL	3.0													3.0
PARADICHLOROBENZENE		73.3	66.5	9.5	35.6		5.5	112.1	54.6	64.5	74.1	2.4	10.3	508.5

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
PARAFFIN BASE MINERAL OIL (ADJUVANT)		3 215.8	20 213.5	1 606.0	17 718.0		1 036.0	15 842.7	72 268.0	6 277.3	34 911.1	2 310.3	13 340.0	188 738.7
PARAFFIN BASE PETROLEUM OIL		76.8	352.8		16.8			252.0	5 786.4	13 521.7	945.6	134.4	1 852.8	22 939.3
PARAQUAT	22.0		69.0		8.0			38.0	1 526.6	5.0	56.0		3.0	1 727.6
PENDIMETHALIN									875.5		45.6		82.1	1 003.2
PERMETHRIN	456.1	80.7	79.6	7.9	253.5		0.01	266.2	94.6	49.8	89.7	2.7	21.8	1 402.7
PETROLEUM HYDROCARBON BLEND		10 467.8	103 939.3	1 453.7	36 759.1		12 144.3	85 113.4	141 946.0	66 844.2	92 624.5	14 283.7	91 012.2	656 588.2
PHENMEDIPHAM					15.0			0.8	363.2				55.2	434.1
PHORATE									40 263.0		106.5		6.0	40 375.5
PHOSALONE		1.0	1.3	0.3	4.3			8.9	1.3	0.6	2.3		1.5	21.4
PHOSMET		0.7										4.2	0.7	5.6
PICLORAM	5 317.5	1 872.1	3 787.0	132.6	1 370.2		9.6	3 947.9	1 710.8	2 963.2	3 974.4	100.6	191.2	25 377.1
PINOXADEN		1 566.1	5 916.3	1.9	2 605.2			6 365.4	364.2	4 130.7	11 688.3	123.2	21.8	32 783.2
PIPERINE	0.02	0.1	0.1	0.02	0.3			0.3	0.1	0.05	0.1		0.04	1.0
PIPERONYL BUTOXIDE	218.0	90.0	88.0	15.2	332.3		0.04	332.1	133.3	113.0	232.6	10.5	42.3	1 607.3
P-MENTHANE-3, 8-DIOL		0.3						0.2		0.6	0.2			1.3
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER		2 081.7	10 252.4	121.5	3 032.1			12 758.5	5 955.8	9 180.0	10 755.6	413.1	1 393.2	55 943.9
POTASSIUM MONOPERSULPHATE	18.2				2.1									20.3
POTASSIUM SALTS OF FATTY ACIDS		20.6	11.5	5.0	274.4			246.7	37.6	20.3	44.1		27.2	687.3
PROMETRYNE													855.5	855.5
PROPAMOCARB HYDROCHLORIDE	536.4				3.6									540.1
PROPANIL											32.0			32.0
PROPETAMPHOS	18.9													18.9
PROPICONAZOLE	470.7	2 291.5	5 443.1	187.5	7 295.4		33.7	3 887.6	13 634.7	976.2	12 576.4	461.9	3 128.7	50 387.5
PROPOXUR	25.8	1.4	1.5	0.2	4.3		0.004	2.7	1.5	1.4	1.7	0.1	0.7	41.3

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
PROPYZAMIDE	53.7	4.8	13.6		99.3			32.2	83.6	54.4	90.6	32.6	10.9	475.7
PROTHIOCONAZOLE		4 078.4	4 263.2	269.3	2 048.4			4 814.1	3 259.8	2 176.3	4 481.6	9.8	1 116.3	26 517.0
PUTRESCENT WHOLE EGG SOLIDS		0.4	0.4					0.2	6.7	1.1	2.6			11.3
PYMETROZINE	6.5				0.2				37.4				11.3	55.5
PYRACLOSTROBIN	15.0	121.9	1 409.8	89.4	364.0			788.6	2 540.6	790.4	1 021.9	4.9	504.1	7 650.5
PYRASULFOTOLE		377.4	1 129.3	53.3	530.8		28.6	794.5	806.3	786.7	1 502.2	108.3	206.3	6 323.6
PYRAZON			5.2					15.5	51.6					72.2
PYRETHRINS	26.8	14.1	13.8	2.4	50.4		0.003	56.5	18.1	17.7	32.8	1.3	6.2	240.0
PYRIDABEN	9.9				340.7									350.6
PYRIPROXYFEN	0.9													0.9
PYROXSULAM		46.3	143.4	1.9	87.1			115.1	505.7	89.8	148.0	2.9	111.2	1 251.4
QUINCLORAC			100.2					96.3			16.7			213.2
QUINTOZENE	6 058.5				1 470.3									7 528.8
QUIZALOFOP P-ETHYL		12.3	59.1		2.7			40.3	925.8	2 163.5	151.3	21.5	296.4	3 673.0
QUIZALOFOP-ETHYL									0.8					0.8
RESMETHRIN	24.2	9.7	5.6	3.4	21.3	0.01	0.01	29.8	7.4	13.5	14.7	1.2	3.3	134.0
RIMSULFURON	0.2		0.6					2.9	197.0		0.5		7.2	208.4
ROTENONE	3.8	3.6	10.9	0.04	3.6			16.2	2.5	4.4	3.7	0.1	0.8	49.7
SAFER'S INSECTICIDAL SOAP	756.5	0.1	0.3		144.5			0.2	0.1	0.1	0.2		0.02	902.0
SETHOXYDIM		858.8	3 269.6	72.0	282.8		21.9	2 338.6	6 356.0	3 112.2	1 820.5	138.6	923.1	19 194.1
SILICA AEROGEL	4.8	319.5	1 278.0		2 214.0		193.5	666.0	12 334.5	778.5	6 181.5	211.5	909.0	25 090.8
SILICON DIOXIDE FRESH WATER FOSSILS		0.6	0.6		5.8			15.3	2.6	2.4	1.5		0.4	29.0
SILICON DIOXIDE SALT WATER FOSSILS	76.8	332.7	749.9	60.6	2 402.1		21.5	2 683.3	5 725.2	458.2	2 656.3	25.3	432.2	15 624.1
SILOXYLATED POLYETHER	972.8	206.7			24.3			60.8	304.0	121.6				1 690.2
SIMAZINE	59.8	2.0	23.2		1 307.1			47.5	2 764.9	5.7	507.5		7.5	4 725.1

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
S-METOLACHLOR									786.9				43.9	830.9
SOAP	12.0	46.3	111.2	8.1	530.2			458.8	40.9	23.7	72.5	0.1	27.9	1 331.8
SOAP (HERBICIDAL)	4.0	18.4	2.8	1.2	80.0			59.6	1.2	11.2	10.0			188.4
SODIUM ALPHA-OLEFIN SULFONATE	291.0													291.0
SPINETORAM	0.2													0.2
SPINOSAD FACTOR A PLUS	17.8				1.0									18.7
SPIROMESIFEN	1.7													1.7
SPIROTETRAMAT	2.4								7.9					10.3
STREPTOMYCES GRISEOVIRIDIS	0.01													0.01
STREPTOMYCES LYDICUS	0.02													0.02
STRYCHNINE	0.4		358.8		95.0			1.7	67.3		65.6		6.6	595.5
SULFAQUINOXALINE	0.04	0.03	0.05		0.03			0.1	0.02	0.03	0.1		0.01	0.4
SULFOSULFURON											5.2			5.2
SULPHUR (FUNGICIDE)	296.3	22.0	246.0	3.2	174.1			489.7	31.0	104.9	106.5	0.6	49.1	1 523.2
SULPHUR (INSECTICIDE)		145.5	202.9		33.5			534.2	67.6	192.7	124.7		13.0	1 314.0
SULPHUR (VERTEBRATE CONTROL)	1 320.3	332.3	1 079.0	11.4	3 081.7			3 473.3	717.4	68.3	1 174.2	11.4	135.6	11 404.8
SURFACTANT BLEND	1 824.0	7 787.4	61 114.4	2 126.8	24 778.6		3 465.0	42 808.3	111 433.9	41 043.5	57 955.5	6 446.7	42 654.2	403 438.3
SURFACTANT MIXTURE	307.2	65.3			7.7			19.2	96.0	38.4				533.8
TEBUCONAZOLE		2 506.1	2 088.4	3.0	1 493.7		140.8	2 374.7	3 062.9	656.5	2 208.6	0.7	1 013.6	15 549.0
TEBUFENOZIDE	15.4													15.4
TEPRALOXYDIM		48.6	1 110.1	14.4	441.9		12.3	545.0	1 413.9	282.7	743.1	102.8	166.5	4 881.3
TERBACIL	11.2							3.2	345.6		30.4		1 337.6	1 728.0
TERBUFOS					9.0				1 515.0		111.0		162.0	1 797.0
TETRAMETHRIN	0.2	0.9	0.6	0.2	8.4			4.2	1.1	0.7	1.8	0.03	0.3	18.4
THIABENDAZOLE								1.8	410.7					412.5
THIAMETHOXAM	25.0	466.2	1 393.5	127.0	230.9		2.2	682.8	986.2	887.7	547.6	32.7	131.9	5 513.7

Active Ingredient	Non-specific basin	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
THIFENSULFURON METHYL		710.8	1 804.3	99.4	393.1			11 552.0	422.4	1 295.9	1 413.6	229.9	422.8	8 344.1
THIOPHANATE-METHYL	208.6	0.7	0.8	0.4	51.4			22.2	513.4	11.2	171.9	5.4	38.9	1 024.9
THIRAM	723.6	2 706.3	13 860.1	141.8	9 230.0		536.7	9 167.9	13 371.2	5 561.7	17 386.2	679.1	2 717.3	76 081.8
TRALKOXYDIM		2 532.8	16 062.1	1 284.8	14 174.4		828.8	12 614.4	55 967.5	4 948.8	27 709.7	1 841.6	9 952.0	147 916.9
TRIALLATE		542.5	13 419.1		8 753.1		5 166.5	5 954.2	42 710.1	1 089.6	17 400.2	1 577.7	4 459.2	101 072.2
TRIASULFURON			7.7								37.8			45.5
TRIBENURON METHYL		525.6	1 987.7	59.8	616.0		4.8	1 573.6	909.8	1 173.5	2 091.7	256.8	756.8	9 956.1
TRICLOPYR	14 659.2	2 712.0	2 258.9	297.6	201.6			2 515.2	537.6	1 315.2	628.8	187.2	364.8	25 678.1
TRIFLOXYSTROBIN	35.6	730.0	1 703.8	63.8	590.4		16.2	1 040.8	1 136.3	160.0	2 006.0	90.1	409.1	7 982.0
TRIFLURALIN		2.3	1 417.8		2 495.3		835.4	2 727.1	10 164.6	220.1	5 294.6	3 443.2	8 130.2	34 730.5
TRIFLUSULFURON METHYL									59.8		9.4		5.9	75.1
TRINEXAPAC-ETHYL	70.1				7.7									77.7
TRITICONAZOLE	71.7	34.5	1113.5	5.6	247.8			404.1	568.3	97.6	425.7	124.4	52.0	3 145.2
UNICONAZOLE-P	0.02													0.02
VINCLOZOLIN		241.2	502.8		1 783.2			1120.0	1 115.4	372.0	206.4		654.0	4 995.0
WARFARIN		0.1	2.0	0.01	1.1		0.01	0.2	0.1	0.1	0.1		0.1	3.8
WATER SOLUBLE DYES					35.1									35.1
Z-9-TRICOSENE	502.0	25.6	55.7	5.2	66.4			91.0	164.2	31.7	126.9	13.3	15.3	1 097.3
ZINC NAPHTHENATE		22.6	19.5	1.1	12.7			50.5	7.0	5.9	31.9		2.2	153.5
ZINC PHOSPHIDE	2.3	0.4	3.2		1.6			113.6	1.6	3.2	0.4			26.3
ZINEB		2.5	1.5		1.6			6.7	7.2	0.5	24.8	1.0	5.8	51.5
Total	**217799.0**	**426562.2**	**1807741.1**	**86065.7**	**974643.7**	**2.5**	**96329.0**	**167396.4**	**2446190.7**	**1404891.3**	**2066587.9**	**238899.8**	**1036386.3**	**12476095.8**